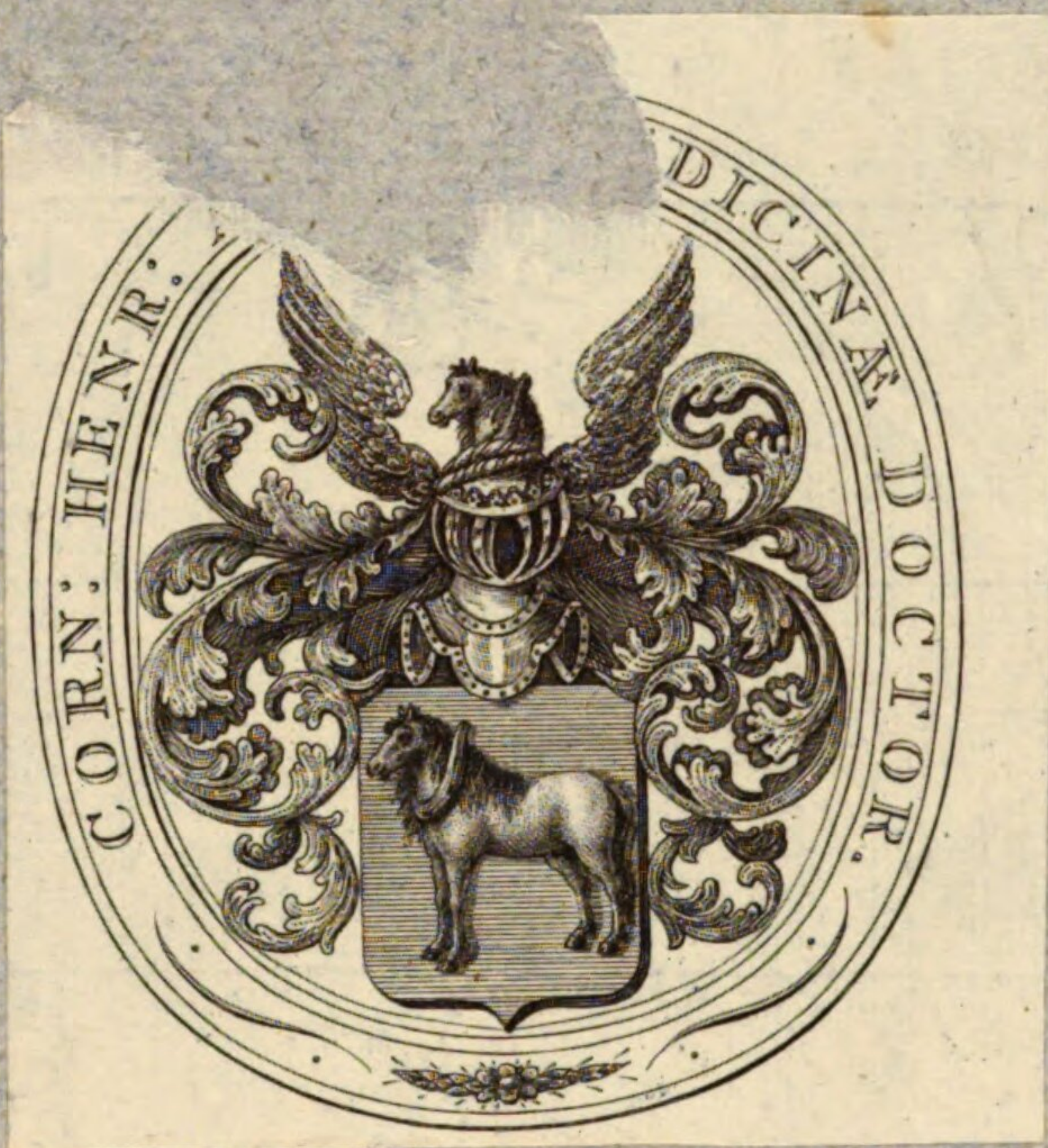


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THE
HISTORY
OF THE
ABSORBENT SYSTEM,
PART THE FIRST.

CONTAINING THE
CHYLOGRAPHY.

THE NEW YORK

HISTORICAL SOCIETY

ABSORBENT SYSTEM

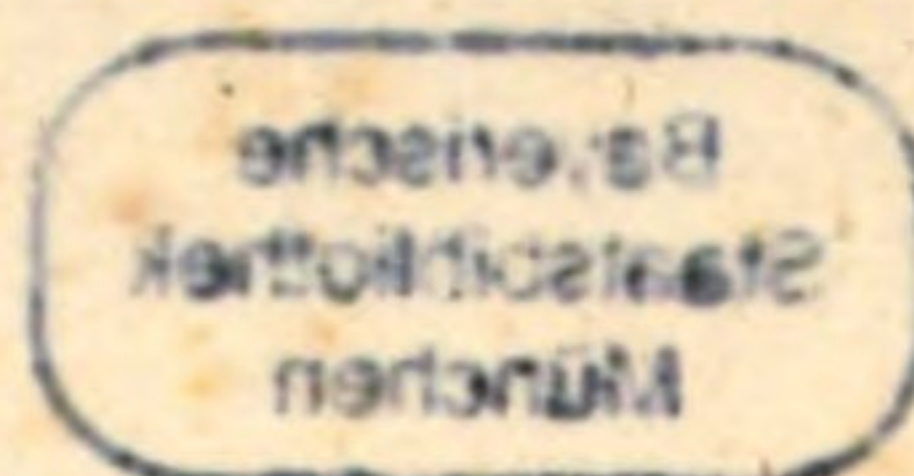
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OR
DESCRIPTION
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HUMAN LACTEAL VESSELS,
WITH
THE DIFFERENT METHODS
OF DISCOVERING, INJECTING, AND PREPARING THEM,
AND THE
INSTRUMENTS USED FOR THESE PURPOSES.
ILLUSTRATED BY FIGURES,
By JOHN SHELDON, SURGEON, F. R. S.
PROFESSOR OF ANATOMY IN THE ROYAL ACADEMY OF ARTS,
AND LECTURER OF ANATOMY, PHYSIOLOGY AND SURGERY.

L O N D O N,
PRINTED FOR THE AUTHOR,
And may be had at his House in GREAT QUEEN-STREET, LINCOLN'S-INN-FIELDS.
MDCCLXXXIV.



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(TO)

SIR JOSEPH BANKS, Bart.

PRESIDENT OF THE ROYAL SOCIETY,

&c. &c.

SIR,

THE following Work is published, in order to throw some light upon a very material, and hitherto almost unexplored part of the Structure of the Human Body,—the Lacteal Vessels; by which fresh supplies are conveyed to the machine, and the waste of the Animal is recruited.

This being a very important subject in Anatomy, which may with propriety be considered, as a branch of Natural History, and the Work having already been honoured with your approbation, to whom could I
more

more properly address it, than to a Gentleman, who has not only cultivated this Science with great assiduity, but by whose patronage and munificence it hath also been so nobly encouraged?

Permit me therefore to request your acceptance of these my first labours, as a small token of gratitude for the several marks of friendship and favour which you have been pleased to confer on,

SIR,

Your much obliged

And devoted humble Servant,

Great Queen-Street,
March 20, 1784.

JOHN SHELDON.

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INTRODUCTION.

AN accurate knowledge of the course, distribution, and terminations of the absorbent, or lymphatic system in the human body, cannot but prove of the utmost importance in the study of the animal œconomy, and in the practice of physic and surgery; since it will assist us in understanding many phænomena that arise in diseases: while a similar investigation of the structure of the coats of those vessels, and of the glands with which they communicate, will be equally beneficial in physiology and pathology. Every attempt therefore, that has hitherto been made to elucidate this new and difficult part of anatomy, when nature has been properly attended to in the descriptions and representations, has ever been considered as a valuable addition to the science.

The first discovery in this branch of anatomy, was accidental; but the accurate knowledge of the system, is the result of much labour; for great anatomical dexterity is required to discover, inject and dissect those vessels, because it is extremely difficult to find them.

This difficulty arises from several circumstances:

1. They are in general void of contents in the dead human subject.
2. Their coats are so pellucid, that it requires the most acute sight of an anatomist, much accustomed to the appearance of the different systems of vessels, to discern and distinguish them from veins or nerves.
3. There is also much difficulty in opening them in such a manner as to be able to introduce proper instruments for injecting them, which in general, (except in the trunk, or thoracic duct) can seldom be effected with any other fluid but quicksilver. The difficulty of injecting even with this subtil fluid is increased, from the minuteness of these vessels in many parts, and from their being crowded with numerous valves, which render it impossible to inject them any otherwise, than from branch to trunk.
4. Great caution and patience are requisite to dissect and prepare the

B

lymphatics,

lymphatics, either for immediate demonstration or future preservation; and the difficulty of dissection is increased, from the necessity of injecting with quicksilver: for if we happen to wound the vessels, our labour will be lost by the escape of that subtile fluid.

We shall still have less occasion to be surpris'd that the ancient anatomists have not discovered more of the lymphatic system, when to the above-mentioned difficulties we add, that they were not so well acquainted with the art of injecting as the moderns. It is owen to the great improvement this art has received of late years, to the invention of new and better instruments for such purposes, and to the greater frequency of dissections, that we have attained our present knowledge of that system.

The first discovery made on this subject in 1622, by Caspar Asellius, of the lacteal vessels, gave the world but very imperfect ideas of this system; as the anatomists of that period knew nothing but the lacteals, which they could easily observe and trace on the mesentery of many animals, where that membrane is transparent, either from there being no fat upon it, or from the fat being placed in the course of the larger trunks of the blood vessels, as in kids, dogs, cats, horses, asses, and most quadrupeds; but as they had not discovered the thoracic duct or trunk of this system, and were unacquainted with the lymphatic vessels, their knowledge of course must have been very imperfect, and particularly as Asellius supposed that the lacteals passed on to the liver, which was considered by them as the hæmatopoetic viscus.

These vessels were seen by many anatomists before the time of Asellius, and accordingly we find mention made of white vessels, (undoubtedly the lacteals) by Herophilus and Erasistratus, but as they were unacquainted with the use of them, that of absorbing the chyle from the cavity of the intestines, which circumstance was proved by Asellius; the discovery of them ought in justice to be attributed to him.

Soon after this, when the dissection of living animals became very common among anatomists, Rudbeck, Bartholine, and Jolyffe discovered the lymphatic vessels; and about the same time, Pecquet the thoracic duct, which last had been seen before, by Eustachius, in a horse.

We owe much to those observers, for their discoveries and remarks upon this interesting part of anatomy; and the names of Asellius, Rudbeck, Bartholine,

Bartholine, and many others, will be celebrated to the latest posterity: we are likewise much indebted to Nuck, for a curious and original treatise on the absorbent vessels; and particularly to Ruysch, Bidloo, and Riolan, for additional observations on this subject; but above all, to Pecquet, for his discovery of the thoracic duct, or trunk of this system; as also to Van Horne, and many others. But I shall proceed to the history of the modern discoveries, since the honour due to the memory of those anatomists, has been amply paid by the late illustrious Haller (*a*), by Mr. Hewson (*b*), and by M. Portal (*c*).

It still remained doubtful, whether the lymphatic system were universally extended over the human body, for neither vessels nor glands could be discovered in many parts, although great pains were taken for this purpose by different anatomists. Neither could any part of the absorbent system be discovered in birds, amphibious animals, and fishes, which classes make so considerable a portion of the animal creation, notwithstanding the repeated researches of skilful practical anatomists. The most able physiologists were therefore of opinion, that as absorption appeared to be carried on by the veins in those animals, so these vessels might perhaps perform the same office, in many parts of the human body.

The discovery of the absorbent system in birds, amphibious animals and fishes, was reserved for two indefatigable English anatomists of the present age, Mr. John Hunter, and the late Mr. William Hewson.

The former had observed the lacteals full of white chyle in the crocodile, an amphibious animal of the lizard tribe; and had likewise discovered lymphatic vessels and lymphatic glands upon the necks of birds (*d*), particularly upon the neck of the swan, a considerable time before Mr. Hewson's discovery of the whole of the absorbent system in those animals. The latter, Mr. William Hewson, by innumerable laborious dissections, instituted on living and dead animals, discovered and injected the whole of the absorbent system in birds, amphibia, and fishes. By these important

(*a*) Vide Halleri Elementa Physiologie. Tom. vii. p. 201.

(*b*) See Hewson's Experimental Inquiries, Part II.

(*c*) Portal Histoire de L'Anatomie & de la Chirurgie, Tom. vi. p. 288.

(*d*) See Mr. Hewson's experimental Inquiries into the Lymphatic System, p. 68.

discoveries he proved the universality of the system of absorbents (*e*), and by demonstrating their existence in the above-mentioned animals, rendered it most probable that the veins, even in them, do not absorb; since they are provided, as well as man and quadrupeds, with a peculiar system for that purpose.

Some material experiments were made before this period by Mr. John Hunter (*f*), to determine whether the veins of the intestines performed the office of absorption, as the generality of anatomists supposed. He injected solutions of musk, and mixtures of indigo and starch water, into the intestinal canals of various living animals, and opening the veins on the mesentery, he examined their contents, when the injected fluids could not be discovered in the blood taken from the mesenteric veins. Both the fluids, however, appeared upon opening the lacteals.

Since then the veins do not appear to perform the office of absorption in the intestinal canal, we have much reason to conclude, from analogy, that they do not perform this office in other parts of the body: for the lacteals and lymphatic vessels are exactly similar in their structure. Among former anatomists, we find some vestiges of the absorbent system in birds, amphibious animals, and fishes, which merit our attention; but they chiefly relate to the lacteals (*g*).

It still remains for some practical anatomist, conversant in injecting and preparing these vessels, to give an accurate history of the absorbents of every part of the human body, where they have been hitherto discovered. If we take the pains to search for, and examine, all the figures and descriptions that have been published on this part of anatomy, before the present time, we shall find that the plates are few in number, very imperfect, and not in the least resembling nature; that they are chiefly taken from the brute creation, copied from one another, or that they are the offsprings of a fertile imagination. We have had some good observations, however,

(*e*) These discoveries of our immortal Hewson, were considered as so important in anatomy and physiology, that they were rewarded, by the Royal Society of London, with Sir John Copley's annual gold medal.

(*f*) See Medical Commentaries, by Dr. William Hunter, Part I. Ch. V. P. 42.

(*g*) Vide Halleri Elem. Physiologiae, Tom. VII. P. 298.

I N T R O D U C T I O N.

v

from Nuck (*h*), Ruysch (*i*), Duvernoi (*k*), Lieberkühn (*l*), and of late years from the present professor Monro (*m*), Dr. Meckel (*n*), and Dr. Hunter, (*o*): but the last and most complete work of this kind, is that by the late most accurate Mr. William Hewson (*p*), illustrated by figures of the lymphatic vessels of the extremities, and of the trunk. In this work, however, though so lately published, we have no representations of the lacteals, nor of the lymphatics of the different viscera of the thorax, or abdomen; the lymphatic vessels of the viscera, and the lacteals in the human subject being very imperfectly known even at the late period of Mr. Hewson's treatise.

To supply this deficiency, the following work is designed; in which I shall endeavour to correct the errors already published on this subject, and shall give figures from nature, of those parts of the system in the human body, where they have been falsely described, and where they have been recently discovered.

It is therefore proposed to publish plates, with a copious explanation of every part of the absorbent system, and to begin with the lacteals.

We shall then proceed to the lymphatic vessels of each particular viscus, where we have been able to discover them by injection or otherwise; and shall endeavour, not only to point out and delineate their course upon, and in the different viscera, but likewise to describe and illustrate as much as possible their terminations towards their common trunk, the thoracic duct, by plates engraved from drawings of the original size, and accurately copied from nature.

Lastly, a view shall be given of the lymphatics, of the superior and inferior extremities in their natural size; and, as a supplement to this work, a specimen shall be added of the lacteal vessels, in quadrupeds, birds, amphibious animals and fishes, in order to complete the whole of the anatomical history of this new and interesting subject.

- (*h*) Nuck, Adenographia.
- (*i*) Thesaurus Anatomicus.
- (*k*) Duvernoi Comm. Acad. Petropol. Tom. I. P. 269.
- (*l*) Dissertatio de Fabrica & Actione villorum Intestinorum tenuium Hominis.
- (*m*) Thesis de Vaf. Lymph. Valv.
- (*n*) Epistola ad Hallerum.
- (*o*) Medical Commentaries.
- (*p*) Experimental Inquiries, Part II.

C

Prefixed

Prefixed to this my first essay on the absorbent system, there is also a chapter on the method of discovering, injecting, and preparing these vessels, with a plate of the lymphatic injecting tube, which will prove useful to all who wish to prosecute these inquiries. This unreserved discovery, I flatter myself, will induce other anatomists to publish with their works, whatever they know respecting anatomical pursuits, or investigations; for the progress of the science has undoubtedly been much impeded by the mystery observed among anatomists, respecting the composition of their injections, and their method of dissecting, injecting, and preparing the different parts: a mystery which deserves the severest censure, and is unworthy of the character of a philosopher or a man.

O F T H E

ABSORBENT SYSTEM.

C H A P. I.

The Method of discovering, injecting, dissecting, and
preparing the Absorbent Vessels.

IT is presumed that this work cannot be more properly begun, than by a description of the contrivances that are made use of, for injecting and preparing the system of absorbents, and of the instruments necessary for those purposes. This information will encourage many practical anatomists to labour upon this new branch of the science, and the accurate knowledge of the system will arise in proportion to the number of persons employed in tracing the vessels, and instituting experiments on living as well as dead animals; so that I shall disclose, without reserve, whatever I am acquainted with on this head. That we may proceed in this point with some kind of order, it will be necessary to consider, 1st, The proper place to conduct such inquiries; 2dly, The instruments and injections requisite; 3dly, The subjects proper for these purposes; 4thly, The method of managing the different parts preparatory to injection; 5thly, the mode of preparing them after injection; which last point naturally includes two circumstances,

cumstances, dissection and preservation ; this will comprehend the whole of the anatomical encheiresis.

1st, With respect to the choice of the place ; a clear steady light, from a northern aspect is most preferable ; for the glare of sunshine is unfavourable to the discovery of these vessels ; and as we prosecute anatomical inquiries chiefly in the winter season, the forenoon, or from ten to two, is the most eligible time ; because, during the winter the light is more clear at that period. I am also convinced, from experience, that the light by passing through the glass of a window, is better for this purpose than in the open air, as the vessels are more distinctly seen. The thinness of their coats renders them apt to dry in the open air, which in a great measure prevents the injecting process. The anatomist will likewise find it necessary to incline the part in different directions to the light, more particularly if he be endeavouring to discover lymphatic vessels upon a surface, as the lacteal trunks, immediately under the peritoneal coat of the intestines, or the lymphatics on the external superficies of the liver, or other surfaces. These will be distinguished with some particular glances of light, and are imperceptible with others. Persons who are used to microscopical observations, are well aware of the necessity of attending to this in their inquiries. I have never derived the least assistance from using magnifying glasses, in order to perceive the vessels previous to injection ; on the contrary, I am persuaded that those who attempt to find them through this medium, will not acquire that *visus eruditus* which is obtained to a surprising degree, by those who have been much experienced in injecting lymphatic vessels. A lateral light, as that from a common window, is also preferable to a horizontal, or perhaps even an oblique sky-light. A table of convenient height, which might be contrived with a ledge, so fixed to the table as to be water proof, would be useful for preventing the quicksilver, which is almost always necessary for injecting these vessels, from being lost. The surface of the table should also be so inclined from the outside to the center, that the mercury which falls upon it may run towards the middle ; where a hole might be contrived with a stopper, to take out occasionally, that the quicksilver might be collected from the table. The quantity of mercury that would be saved by this machine to an anatomist who works much, would soon pay for the expence of it ; this table will

will also hold water for the purpose of steeping membranous parts, which we frequently have to inject, which, from being exposed to the air, become dry, and which it is often inconvenient and hazardous to move into water, when we are at work upon them: or if a ledge be fixed, as above described, to a common horizontal table, and a hole cut to adapt a receptacle, the mercury might easily be swept into the center: this hole may be made round or square according to the fancy of the anatomist; it should be constructed of such materials as are not liable to warp or split even in warm water. If the anatomist be not provided with such a table, the parts should be laid in a tray, or earthen dish, that the quicksilver may be saved.

Of the Injections.

THE injections that are used for filling the lymphatic vessels and their trunks, are mercury, and the ceraceous or coarse injection, as it is called by anatomists; the former is always used in injecting the lymphatics and lacteals, as it is almost impossible to fill them with any other fluid in the dead body; the latter, or ceraceous, is generally employed to inject the thoracic duct; in some particular instances, where the lymphatic trunks have been found larger than the ordinary size, a coarse injection has been used (*a*).

In experiments on living animals, other materials can be made use of with great convenience and advantage, by injecting such fluids into the cavities of the alimentary canal, as will be readily absorbed; for instance, the feeding of dogs and other animals with milk, previous to the strangling of them, the opening of the animal and perforating the small intestines, and throwing in starch water, with solutions of musk, or mixtures of indigo and starch water, as practised by Mr. Hunter (*b*), have greatly contributed towards making discoveries upon this system: in a word, any gelatinous fluids, rendered opaque with such colours as will be absorbed,

(*a*) The present professor Monro has a preparation of the lymphatic vessels of the thigh, filled with a coarse injection, in a subject where he found them of a large size. I have likewise injected some of the human lacteal vessels with a ceraceous composition.

(*b*) See Dr. Hunter's Medical Commentaries.

are extremely useful for experiments of this kind ; for much more can be seen by examining the vessels distended with a coloured fluid from natural absorption, than by anatomical injection practised in the dead body, and these parts may be readily preserved for future inspection, as shall be taken notice of hereafter. If such experiments had not been made, we should still have doubted whether the veins did not perform the office of absorption. The first discovery of the ampullulæ by Lieberkühn arose from feeding scrophulous children, in whom the lacteal glands were obstructed previous to their death, with milk ; by which means not only the lacteal trunks became distended with chyle, but likewise the ampullulæ. The experiments succeeded much better in these subjects from the chyle being stopped in the vessels by the obstructed cells of the lacteal glands. Thus the first origin, and even the absorbing mouths of the lacteals were discovered by that lynx-eyed anatomist (c) ; and the first discovery of the lacteals by Asellius, was also made from the vessels being distended with the chyle. Eustachius saw the thoracic duct in a horse, by observing it full of chyle ; and our immortal and ever to be regretted Hewson, traced the lacteal vessels, lymphatics, and thoracic duct, in birds, by making ligatures on the root of the mesentery, and other parts, in living geese, which he had previously fed with barley. Mr. J. Hunter also traced the lacteals in the crocodile, from their being loaded with chyle. By such modes of investigation we may discover many parts of the absorbent system, which are perhaps at present concealed from us ; and which we may never be able to discover by injections practised on the dead body, or by any other method.

The quicksilver used for injecting the absorbent vessels, should be as pure as possible : it is frequently adulterated, by being mixed with lead : it should be perfectly dry and free from all extraneous matter, which may frequently be skimmed from the surface of the mercury, by exposing it in a faucer, or by passing it through chamois leather ; if wet, it may be readily dried by wiping it in an open vessel with lint, or linen. The coarse injection is made of yellow resin and pure mutton suet ; the proportion, two-thirds of resin to one third of suet. If it be required of a firmer consistence, a small quantity of pure wax may be added ; if of a

(c) Vide Lieberkuhn Dissertat. de Fabrica, &c.

softer quality, the quantity of suet must be increased; for the colouring powder, king's yellow, or orpiment is generally made use of; other colours may be employed, as Prussian blue, flake white, verdigrease, or vermilion.

Of the Instruments.

THE instruments necessary for an anatomist, who is preparing to inject lymphatic vessels, are, the lymphatic injecting tube and pipes, lancets, blow-pipes, knives, scissars, forceps, needles and thread. With respect to the lymphatic tube and pipes, which are the most material instruments, I have thought it necessary to represent them by a plate; for the success of the anatomist depends very much upon the perfection of this instrument. The old instrument for this purpose, where the pipe is fixed to a glass tube of two or three feet in length, is of no use; and this is one reason why practical anatomists, before the time of our Hewson, have been able to inject so little of this system; such long tubes are utterly unmanageable by one person, and if two be employed nothing can be well done; the operator should hold the instrument in his hand like a pencil or pen.

The instruments I use, which are as manageable in the hand, when loaded with mercury, as the pencil is, are represented in Plate VI. These tubes are made either of glass or brass; the advantage of glass is, that we can readily observe when the quicksilver descends in the tube. The disadvantage is, that it is more easily broken than the brass one; the brass one is inconvenient from its opacity, and is liable to be amalgamated by the mercury; but this last disadvantage can be obviated by waxing the inside of the tube, which is effected by warming it, and introducing a small piece of wax, and shaking it in the tube, so as to line the inside of it.

The glass tube is represented in Tab. VI. Fig. 1. which, as well as the other instruments there delineated, is of the natural size; the superior extremity of the tube is made like the upper part of a funnel, for the convenience of pouring in the quicksilver, the other end has a collar of steel *a*, cemented to the tube, in which is a female screw *b*, to receive the steel pipe Fig 2, by means of a male screw *c*; this pipe is screwed to the collar that

that is fixed to the tube, by laying hold of the godronned edge *d* with the fingers: the screws should be well fitted to prevent the mercury from escaping; and both the collar and pipe must be made of iron or steel, as brass and every other metal is liable to be amalgamated by the quicksilver; the screws should likewise be kept well oiled to prevent them from rusting. The pipe *e* is by far the most difficult part of the instrument for the workman to execute; it should be drilled out of the solid metal, and not made of a flattened piece of iron beaten over a core or cylinder, and the sides soldered together, as they sometimes are by indifferent workmen. The last are subject to grow jagged at their extremities, are liable to cut the vessels, and cannot be easily introduced; the folder is likewise apt to be amalgamated by the mercury, so that these pipes soon drop to pieces.

The pipes I use for injecting lymphatic vessels, are made by drilling a hole through a piece of proper tempered wire (*d*). The pipe *e* must be accurately fixed in the bottom of the part *d*, which must have a hole so turned in it, as to correspond above to the bottom of the tube, and below to the upper part of the steel pipe *e*; a piece of chamois leather, with a hole punched in it, must be put over the screw so as to lie between the bottom of the collar *a*, and the part that applies to this bottom in the piece *d*: to prevent the mercury from passing out at this joint, it will be necessary that the anatomist should be provided with several of these pipes, of different sizes; they may be made, either with a godronned edge, for the purpose of taking hold of them to unscrew them; or perhaps to greater advantage, with a square piece, as at Fig 7, where *b* marks the square piece into which the pipe is fixed, as before described; and upon which, to screw or unscrew, is used a plate of brass or iron, Fig. 8, with a hole *a*, fitted to the part *b*; by which means the steel pipe can be shifted with greater facility. Fig 6, represents the brass tube of the proper form and size, as made by the London workmen; *a*, a collar of the same metal, which is fixed to it, containing a female screw as in the former described; the mouth of the tube might be made more capacious, as in the glass

(*d*) The best, and those I have represented in the plate, were made by Mr. Evans, Surgeon's Instrument Maker, in the Old Change, near St. Paul's Church. They have been likewise as well made by Mr. Fike, Surgeon's Instrument Maker, in Russel-Court, Drury-Lane, London.

through

one, with more advantage; or the mercury may be poured in through a small funnel, made with a piece of paper, or card rolled together; or through a glass funnel. Fig 4. represents a very small steel pipe, made similar to that in Fig. 2; except that the pipe is curved, which I have found convenient to inject the lymphatic vessels occurring upon surfaces, such as very small trunks and branches of lacteals, &c.

Fig. III. Represents a small piece of iron wire polished, which is to be kept bright and oiled; it is used to clean the pipe from the dust that may lodge in, and obstruct it, and is always to remain in the cavity, except when used; when passed into the pipe, it should be carried from above downwards; it must be made of annealed wire, for if made of hard tempered wire, it will be liable to break in the cavity, and the workmen will have much difficulty in getting it out.

Fig. V. Represents a crooked iron wire, used for the curved pipe. It will be necessary that the anatomist have a proper case to lay these instruments in, for the convenience of carrying them about. Smaller pipes than these may perhaps be required; and accordingly, I have sometimes been obliged, though seldom, to use pipes of less dimensions, which I have made by drawing out thin glass tubes into capillaries; these we can make as fine as we chuse: they are indeed very apt to break, but are easily repaired with the flame of a lamp or candle, by the injector. Tubes of this kind (if the anatomist cannot make them) may be had of the artificers of thermometers and barometers, commonly called lamp-blowers: these tubes should be thin, that they may readily melt with the fire; and they may be had at the glass-house. A steel stop-cock has sometimes been fitted in the collar *a*, Fig. 1, with advantage.

2d. Lancets.—Exquisitely sharp spear-pointed lancets, are necessary to cut into the lymphatic vessels; a blunt lancet, or any other instrument is improper for this purpose. 3d, Blow-pipes.—The small silver blow-pipes, which are usually put up in the dissecting cases, by the London Instrument Makers, are very well adapted for inflating the lymphatic vessels; and these I have constantly used: dissecting knives, fine pointed scissors, accurately made dissecting forceps, together with straight or crooked needles, are requisite. Steel blow-pipes may likewise be substituted with advantage, as they are not affected by the quicksilver.

The subject to be chosen for injecting any part of the absorbent system should be as void of fat as possible: I have always found those subjects who have died universally dropical, or of an ascites and anasarca of long continuance, the best, for the following reasons: in such subjects there is little or no animal oil, and a very small quantity of red blood; both which fluids, when they occur in great quantity in the body, obscure and retard us in the discovery of these vessels. When the cellular substance of the different parts is loaded with water, the absorbents are more readily perceived, more distinct from each other, and of course traced with much greater ease, and less risk of wounding them in dissection; and the preparations, particularly the dried ones, are rendered more lasting. This is found to be of most consequence in preparing the absorbent vessels of the extremities, and of the trunk, in the human subject; for the vessels are distinguished with greater difficulty in the extremities, than upon surfaces, as on the liver, intestines, &c.

The viscera and extremities of any other subjects than adult ones, are very improper for dissecting the absorbent system, except the liver and lungs, and these may be injected successfully, even in the fœtus. If the anatomist be dexterous in distinguishing the vessels, it is better to take the parts immediately after death, as he will be more likely to find lymph or chyle in the vessels, and have the advantage of the parts being in a recent state, and consequently of a much greater length of time to pursue his object.

In living animals, the best method of discovering the lacteals (and that which is most commonly practised) is, to feed the animal with milk about two hours previous to the killing of him. As soon as the animal is strangled, the root of the mesentery is to be tied; by which means, although the progress of the chyle will be stopped, the absorption from the intestinal canal will take place for some time; I believe, as long as the muscular irritability or peristaltic motion of the intestines remain. The lacteals will of course be distended with the fluid; and as the chyle is prevented by the ligature from passing into the thoracic duct, they will become very turgid, and will be distinctly seen.

I have prepared the chyle in the vessels so circumstanced, by immediately plunging the intestines and mesentery (with the ligature upon the parts) into

into rectified spirit of wine. This process will coagulate the chyle, and the fluid being opaque, the vessels will be beautifully seen when we mean to prepare the parts by preserving them in proof spirit as wet specimens: in this way I have made in the dog one of the most natural preparations that can be seen, of the lacteals injected from their orifices by the natural absorption. We may also prepare the lacteals by the same method as was used by Mr. Hunter, and which is described in the introduction to this work, page iv. They will then become very conspicuous, from the indigo which will be absorbed from the cavity of the intestines. We can bring to view and trace the absorbents of most parts of the animal, by tying the thoracic duct near its insertion into the angle formed between the jugular and subclavian vein on the left side; or by tying the jugular and subclavian veins on both sides, we are capable of distending almost the whole of the absorbents of the animal. By these precautions we are enabled to pursue these vessels in many parts, where they have not before been discovered, where it is very difficult to trace them by injection, and even in some parts where it is utterly impossible for the injections to reach them.

I have been able to trace the absorbents in some parts by another method, which I believe has been first practised by Malpighi, that is by putrefaction. If we steep the parts in water, and change the water as long as it is tinged by the blood being soaked out of the blood vessels, suffering them afterwards to remain in the same water till putrefaction begins; the fixed air that is let loose by this process will get into the absorbents, they will be easily seen, may be opened, and injected with quicksilver. It is remarkable that this method will not answer in general so well in the human subject as in quadrupeds; the fixed air can never be made to pass by putrefaction into the human lacteals, at least this event has never once happened in any intestines that I have macerated; yet it will take place in the lacteals of the horse or ass, and many other animals: and drawings of the lacteals can be made by this method to very great advantage. This process may be successfully adapted upon the liver, heart, and some other parts of the human body.

Ligatures may likewise be fixed on the large trunks of the vessels, previous to the steeping of the parts in water, in order to confine the air that
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is let loose in the vessels by the putrefaction, and to render them more turgid. If ligatures were applied to the wrists, and to the legs immediately above the ancles of subjects *in articulo mortis*, or immediately after death, the lymph would be stopped in the lymphatic vessels below the ligatures, they would become distended, and might be injected with the greatest facility by the common method, previously taking off the ligature (e). It is of no use in some instances, where we are searching after the lymphatic vessels in the extremities, to make a ligature as before described, and for some time to stroke firmly the fingers and toes, and other parts, towards the ligature; by which means the small quantity of lymph that remains in the lymphatic vessels will be forced upwards, and arrested by the ligature; the vessels will then be seen by dissection, and may be readily injected: all these circumstances will be found of considerable use to the practical anatomist, upon different occasions.

In order to inject the vessels, it is necessary to open one or more of them according to the anatomical structure of the part, directing the point of the lancet, in almost all cases, towards the trunk, or trunks, of the vessels; and taking care not to carry the incision through the opposite side of the coats. If the vessels should lie under the peritoneum, as the lacteals do, or under the pleura, as the lymphatics of the lungs, we may cut into the cavity of such vessels through these membranes. In injecting those of the extremities, and in many other parts of the body, it is absolutely necessary to dissect the lymphatics we are about to fill, from the adjacent fat, and reticular substance, before we attempt to open them with the lancet. I have before observed, that the lancets used for cutting into the cavities of the absorbents, must be exquisitely sharp; they are better, in my opinion, if spear-pointed: the opening made in the vessel should not be larger than is necessary to introduce the pipe. The tube, with the pipe affixed, is previously to be filled by the assistant, with dry pure quicksilver; the anatomist keeping his eye upon the puncture, takes the blow-pipe, and observes by inflating the puncture, whether the vessel be

(e) The best method of making the ligature is by a tournequet. I have reason to believe that absorption goes on as long as the muscular irritability remains, which last continues for a considerable time after the general life of the animal is lost.

opened;

opened; if he has succeeded, he takes the tube from the assistant, still keeping his eye upon the puncture, and holding it just above the collar like a pen, he introduces it, by means of the puncture, into the cavity of the vessel; taking care to carry it no further than is necessary to give the mercury a free passage. If he should endeavour, as most beginners commonly do, to carry it far into the vessel, by way of security, the end of the pipe will be pushed against the side of the vessel, and the quicksilver stopped. If the mercury should not issue from between the outside of the pipe, and the inside of the coat of the vessel, it will be unnecessary to tie the pipe in the lymphatic. Care being taken to make the puncture small, the pipe will fill up the orifice, and the tying of it should be avoided if possible, because the assistant, unless he be very dexterous, will frequently force out the pipe, in attempting to fix the ligature. If the quicksilver should pass on with freedom in the vessels, we need only pour more of it into the tube as it descends; but if it be at a stand, we must press on the mercury in the vessel with our fingers. This pressure must be carried on higher and higher, in the course of the lymphatic, till we come near the gland, or glands, into which the vessels terminate; otherwise we shall seldom get the cells of the glands, or the vessels emerging from the opposite side of the gland well injected.

In injecting the lymphatic vessels of the superior and inferior extremities of the human body, it is useful to raise the part where the pipe is inserted higher than the other end of the limb, and to make the assistant press with his hands along the skin, in the course of the vessels, which will favour the progress of the injection. When the vessels are sufficiently filled, (which the anatomist determines by the turgescency of them, evident to the sight and touch, and by the resistance made upon the quicksilver in the tube,) the assistant passes a thread by means of a needle, if necessary, under the vessel, and ties it above the puncture, before the anatomist withdraws the injecting pipe.

The method of injecting the larger trunks, or thoracic duct, with the ceraceous or coarse injection, is exactly similar to that of injecting the veins; and is so well known to all practical anatomists, that no description of it is necessary in this work. I would recommend, however, the use of some pipes formed in a particular manner, which I contrived many years

ago, for passing into small vessels, especially veins, as I have found them very convenient. This improvement consists in shaping the ends of these pipes like the mouth of a pen, taking care to make the edges and point blunt, to avoid cutting the vessel when we introduce them. The vessels will admit much larger pipes of this form, than of the common sort; neither is there any occasion to make any bulb or rising near the extremity of these small pipes, to prevent the thread from slipping off, for this will certainly hinder us from inserting pipes of so great a diameter, as we otherwise might. The coarse injection being more liable to cool in passing through a small, than through a large area: it is an invariable rule with anatomists to introduce pipes as large as possible, without running the risk of lacerating the coats of the vessels.

Let us now proceed to describe the method of dissecting, preparing, and preserving the vessels, so as to demonstrate them immediately, or to preserve them for demonstration at any future period. Great caution and patience, as I have before observed, is absolutely necessary, in pursuing the dissection of these vessels, to avoid the wounding of their coats, which are exquisitely thin, and to prevent the mercury from escaping. If this accident should happen, we must introduce the pipe at the ruptured part, and having secured it above and below by ligatures, we must fill the collapsed vessels again.

The knives I would recommend for the dissection of the lymphatic system, are such as are used by the French and German anatomists, in tracing the nerves. They must be made thin in the blade, like lancets, and not much larger. A variety of different shaped blades, some single, others double edged, will be found useful for working on different parts; the common and chief fault of our dissecting knives is, that they are much too thick in the blade, so that they soon get round on the edge, and require perpetual grinding: this is not the case with those I have recommended. The forceps for these dissections should be sharp pointed, that we may be able to lay fast hold of the smallest portion of cellular substance with them; they should not however be so sharp as to endanger the puncturing of the vessels: nor should they by any means be bowed, but extremely easy in the spring, that they may not tire the fingers of the operator in working; and they should be made so as to hold large, as well as small portions of reticular substance. Fine pointed scissors, and lancets

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in fixed handles, are sometimes necessary for these dissections. It is frequently of use to plunge the parts into water, in order to loosen the reticular membrane, connected with the outside of the coats of the vessels, by which means they will be dissected with greater facility, and less risk of wounding them. The blood, if any quantity should remain, may be soaked out by changing the water repeatedly. The parts should not be suffered to remain long in water, after being injected with quicksilver, because the volatile alkali, which escapes from the part by putrefaction, is apt to decompose the mercury, to make it of a dark colour, and to change it into a black powder; by which means the preparation is spoiled.

After dissection, the part is to be preserved, either as a wet or dry preparation, according to its particular nature, or in some cases, according to the fancy of the anatomist. Preparations of the larger masses, as the trunk and extremities, should be preserved dry, for which purpose they should be placed in proper attitudes, exposed to a current of air, but by no means to the rays of the sun, and the vessels should be displayed in their natural situation. When the preparations are dry, both the vessels and fleshy parts should be varnished over, either with good white spirit, or copal varnish, to preserve them from insects, to render them more beautiful and lasting, and to make the vessels more conspicuous. They should then be inclosed in glass cases, handled as little as possible, and remain always in the horizontal situation. It will likewise be expedient for the anatomist to make drawings, of any thing remarkable or new in any preparation of the lymphatic vessels with quicksilver; for most of these specimens, particularly those that are dried, such as the extremities and trunk, become very much impaired, and totally destroyed by the vessels growing indistinct, and at last invisible, from the decomposition of the mercury, by the escape of this fluid from the vessels, or by the opacity of the varnish with which they are covered.

Preparations of the thoracic duct are generally made by filling the vessels with coarse injection below the right crus, or little muscle of the diaphragm; the aorta, superior cava, and vena azygos, or intercostalis, being previously filled with a similar injection. The duct is sometimes prepared with quicksilver; this, although inconvenient for common preparations, because the mercury is continually escaping from the vessels,
may

may still be of use for particular purposes. Thus, for instance, if we wish to demonstrate the valves in the thoracic duct, or any other large absorbent vessel, we need only inject the vessels with quicksilver, dissect and dry them, then cut them open, let the mercury run out, and the valves will be shewn by making sections in the sides of the coats of the vessels. This may be done still better, if the vessel be varnished three or four times before the sections are made, because the varnish will strengthen the sides of the vessel. The valves in the cavities of these parts may likewise be demonstrated in wet preparations, by opening them; or by inverting the vessels and suspending them in proof malt spirits. In this manner the valves that cover the terminations of the thoracic duct on the inside of the angle, formed between the jugular and subclavian veins on the left side, and those that guard the terminations of the lymphatics on the right side of the neck, right arm, and right lung, may be beautifully demonstrated, if preserved in spirits.

Specimens of the lacteal vessels, of the absorbents of the heart, lungs, liver, diaphragm, spleen, kidneys, and other viscera, may be kept wet or dry, according to the particular nature of the preparation, or view of the anatomist. It is useful to dry some preparations, and afterwards to put them in glasses with oil of turpentine, by which means the flesh will be rendered transparent, the vessels will be distinctly seen, and the specimens become exceeding beautiful. The chief disadvantage of these preparations is, that the parts upon which the vessels pass, do not by any means preserve their natural bulk or appearance, on account of their being dried: a disadvantage which the wet preparations are exempt from; a circumstance, which, in my opinion gives them a very great superiority over the former, since they are of course more exact representations of nature. It is frequently necessary to fix some preparations of the absorbents that are to be preserved in glasses, in spirits, or oil of turpentine, on pasteboard, or stiff paper of different colours, in order to support them. They become so heavy from being loaded with mercury, that they cannot properly be suspended, so as to be viewed, without this contrivance. The coloured paper is of use in forming a ground, or proper contrast to the lymphatic and other injected vessels. The small preparations that are preserved in spirits, or oil of turpentine, may be kept in bottles closed with well fitted stoppers;

stoppers; the larger in common preparation glasses. Some years ago I contrived a method of closing these preparation glasses, which I have used with great advantage; and by which I have preserved an infinite number in my cabinet. The method is simple and easy to execute; and renders the preparations nearly as durable as the glass that contains them. In order to execute it, let the anatomist take care to have the upper surface of his bottles made plane, by desiring the workmen at the glass-house to flatten them in the making. This they will easily do in forming the round ones, but in the making of flat bottles the circumstance is attended with considerable difficulty. The right way to make these last, I believe, would be to blow them in moulds of various sizes; the workman should likewise form the bottoms of the bottles perfectly flat, in order that they may stand upright and steady.

Having provided ourselves with bottles of this form, for our larger preparations, we grind the upper surface of them on a plane plate of lead, about the fourth of an inch in thickness, and two feet in diameter; first with fine emery and water, and afterwards with powdered rotten stone, or putty (*f*) first wet with water, and at last dry, so as to render the surface a horizontal plane, and of as fine a polish as plate glass; which will soon be done, as the manœuvre requires little dexterity. The anatomist should be provided with a quantity of glasses prepared after this manner, to be ready upon all occasions. To the top of each bottle a piece of plate glass, cut by a diamond, is to be adapted, so as completely to cover, but not project over, the edge of the bottle. When these two plane surfaces are placed on each other, and a drop of water put between; the attraction of cohesion is so considerable that it requires great force to separate them. Many preparations of the lymphatics, and other parts preserved in bottles, do not require any strings to suspend them; particularly those that are fixed on portions of pasteboard, or stiff paper; and such as require suspension should be tied to strings fixed to the preparation below, and to small holes drilled in the substance of the glass at the bottom of the neck; or to small bits of glass, that may be fixed on the inside of the same part. The preparation is thus suspended, if necessary, in limpid proof malt spirit; the bottle is to be almost completely filled with the spirit; the up-

(*f*) A preparation of tin so called.

upper and polished surface of the bottle, and the plate of glass, are to be wiped clean and dry; a drop of the solution of the solid gum arabic in water, is to be applied on the polished surface of the bottle, the top is to be strongly and steadily pressed upon it, so as to bring the two surfaces in as close contact as possible; and the bottle should then be put in a cool airy place to dry. In two or three days after, we take a piece of the bladder of an ox or horse, free from fat, and soaked so long in water as to become mucaginous. The water being well pressed out, and the bladder carefully wiped with a dry coarse cloth, it is then to be placed on the top of the cover of the bottle, and brought into close contact with it, by carefully expressing all the air that may have insinuated itself, between that and the inside of the bladder. The bladder is next to be drawn tight over the neck of the bottle, and a piece of fine hard bound packthread, previously covered with the gum arabic solution, by means of a camel's hair pencil, is to be carried round the neck of the bottle, placing one turn of the string cautiously below the other, so as to bind it equally strong on every part of the neck. The string is then to be tied firmly, the bladder is to be cut neatly off under the last turn of it, by a sharpknife or lancet, and the bottle is again to be put to dry, with the above mentioned precautions. When it is perfectly dry, the string is to be taken off cautiously, by cutting the knot, and beginning at the end that leads to the turn last applied. The top and neck of the bottle are then to be painted, with a composition made of lamp black, mixed with japanner's gold size: this soon dries and leaves a fine smooth glossy surface, from which the dirt can at any time be as readily wiped off, as from a mirror.

This method may appear to many anatomists complicated, and to require more time than the ordinary mode. But, on the other hand, it should be considered that it renders the preparations extremely durable; and that the labour of grinding and polishing may be consigned to a common servant, who will execute it with great expedition. In this way likewise, it is only necessary to tie the bottles once over; whereas in the common mode, practised in this country, we are obliged to tie them twice. Evaporation too, if the operation be well executed, is totally prevented by it: and the further trouble of opening the bottles, and renewing the spirits, as well as the expence of fresh spirits saved. All these circumstances

stances taken together, I flatter myself that this will be looked upon as a very considerable improvement, since it certainly comes nearest to the sealing of bottles hermetically, which it is impossible to effect in common preparation bottles; nor would it answer for the ordinary purposes of practical anatomy, if even it could be done. Large bottles are as effectually secured by this contrivance as small ones. Simple as the practice may appear, it has cost me, however much application and expence, before I could bring it to that state of perfection in which I now constantly use it, and with so much advantage. If the bottles do not stand steady, from the bottoms being uneven, we can easily grind them level with emery, on the above mentioned plate. I have discovered lately that if the tops be gummed, in the manner I have described, on the bottles, they will remain perfectly fixed without the bladder; although in the common upright bottles, it may be most adviseable to put it on, as a defence to the top. Since I have found that the tops can be firmly secured without the bladder, I have used flat glass faucers, and have exposed several preparations to great advantage in such vessels, in a horizontal situation. I have thus exhibited very early abortions in their membranes, and other preparations that cannot be conveniently suspended or viewed in the perpendicular direction, by fixing covers of plate glass on them, as before described, without the bladder. Some very delicate preparations, particularly those intended to be viewed with the microscope, those of the *ampullulæ lacteæ Lieberkühnii*, and those of the valves of the absorbents, may be preserved either in spirits or dry, in such tubes, to the greatest advantage. Some of the dry ones too, may be placed in square or oblong boxes, made of pieces of plate or common glass neatly gummed together, with narrow slips of white or coloured paper, and the objects may be viewed in this manner with convenience. In a word, many new contrivances in this way, will suggest themselves to the ingenious practical anatomist. With respect to the stopper bottles, which are very convenient for keeping small preparations, I would advise that the stoppers be perfectly well ground, that they pass rather lower down than the neck of the bottle, for the convenience of drilling two small holes, obliquely through the inferior edge of the substance of the stopper, opposite each other, for the passing of threads to fix the object; for if the threads pass between the neck and the stopper, a
space

space will be left, or if the stopper be well ground, the neck of the bottle will be broken in endeavouring to press it down. On the other hand, if any space be left, the thread will act from capillary attraction, raise the spirits from the bottle, and cause evaporation, which will likewise take place from the chink between the stopper and neck.

I have now finished the whole of the anatomical encheiresis, and discovered, without reserve, every circumstance which may prove useful to those, who wish to trace and prepare the absorbent system. The height of my ambition will be to increase the number of practical anatomists, and to raise a spirit of emulation among them, which may tend to the further progress of the science, particularly in this important, and hitherto almost unexplored, track of anatomical knowledge.

C H A P. II.

CHYLOGRAPHY; or a Description of the LACTEAL VESSELS.

On the Discovery of the Lacteal Vessels, the Structure of their Coats, the Ampullulæ Lieberkühnii, and the Manner in which Nature produces Absorption in the Lymphatic System.

ERASISTRATUS, who flourished about 300 years before the Christian æra, appears to be the first anatomist who saw the lacteals; he perceived them in dissecting new-born kids, in whom they were distended with the opaque chyle, as in other sucking animals; he found them passing the whole length of the mesentery, and thought they were arteries filled with the milk which the animal had taken for food. We have no reason to suppose, from the account Galen (*a*) has given on this subject, that he had the least idea of their structure or use. Herophilus (*b*), who was cotem-

(*a*) Γαληνὸς εἰ καὶ αὖθις ἐν ἀρτηρίαις αἷμα περιέχεται, Βιβλίον. Editio Charteriana. Tomus tertius, p. 154.

(*b*) Γαληνὸς περὶ χρείας τῶν ἐν ἀνθρώπῳ σωματικῶν μορίων, λόγος τετάρτος. Κεφάλαιον ιθ'. Editio Charteriana. Tomus quartus, p. 392.

porary with Erasistratus, likewise saw the lacteals in young animals, which he said were destined to nourish the intestines: it was his opinion that they did not go to the vena portarum, like other veins, but that they tended to certain glandular bodies in the mesentery. Galen (*c*) also, who saw the lacteals in the kid, said they were arteries: that they were full of the milk, and went to the glandular bodies at the upper part of the mesentery; that they did not go to the liver, and that they nourished other parts beside the intestines. In one place he thinks they are arteries, and in another, he is of opinion they are veins: he appears indeed to have known nothing more upon this subject, than what he borrowed from Herophilus, whose idea he adopts when he says they go to the glandular bodies in the mesentery. Upon the whole, it is evident that the ancients had no adequate notion of their distribution, anatomical structure, or use.

We meet with no further account of the lacteal vessels till the time of Afellius. Some indeed have supposed that Eustachius knew, and had represented them in his Plates; but Haller (*d*) is clearly of opinion that those vessels which have been taken for lacteals, in the plates of Eustachius, are arteries and veins, in some measure concealed by the folds of the mesentery.

The discovery of these vessels by Afellius (*e*), as I have before observed in the introduction to this work, happened on the 23d of June, 1622, when at the desire of many of his friends, he was going to make some experiments on the recurrent nerves and diaphragm, by opening a living dog, that had taken food a short time before the dissection. In order to discern the motion of the diaphragm, he opened the cavity of the abdomen; and observes, that in pushing down the stomach and intestines towards the cavity of the pelvis, he perceived, upon the surface of the mesentery and intestines, great numbers of small white threads, which at first sight he took for nerves, but soon after discovered his error, by remarking that the nerves had a very different appearance; surpris'd at the novelty of the

(*c*) Locus ultimo citatus.

(*d*) Element. Physiol. Tom. vii. p. 201.

(*e*) Afel. de Lactibus, seu lacteis venis, quarto mesaraicarum genere novo invento dissertatio cum figuris elegantissimis. Mediolan. 1627. Basileæ. 1621 in 4to. Ludg. Batav. 1640, 1641, in 8vo. 1645 in fol. cum oper. Spigelii.

fact,

fact, he suspended his experiments, and passed over in silence the knowledge he had before obtained of the mesentery, and of its vessels. To dissipate his doubts, he opened one of the largest of these white cords. No sooner had the incision been made, than he saw a fluid like milk, or cream, issue from the cavity of the vessel. Asellius says he could not contain his joy at the sight of this phenomenon, and turning himself to Alexander Tadinus, and the senator Septalius, who were present, he invited them to enjoy this spectacle; but, "his pleasure, he adds, was of short duration, for the dog died and the vessels disappeared." The natural and simple manner in which Asellius expresses himself, faithfully represents, as M. Portal observes, his astonishment, and gives an idea of the sensation which all anatomists experience at the instant of making any interesting discovery. To confirm this fact, Asellius soon after opened another dog, and his surprise was very great when he could not perceive the least vestige of these vessels: he then opened a third, having previously fed him, and the chyliferous vessels were again conspicuous. Still there remained a doubt whether the lacteals existed in all animals; to be convinced of this, Asellius bought those he could procure: among others he informs us, that he purchased a horse, which he opened soon after he had taken food, and found the lacteal vessels.

Asellius wished much to see them in the human subject, but he was not rash enough to open a living man. His words are, "*Hominem vivum, quod tamen Erasistratus olim, et Herophilus non timere, non incidi*" (fateor,) *nec incidam, qui nefas et piandum morte (cum Celso) existimo, præsidem salutis humanæ artem, pestem alicui, eamque atrocissimam inferre.*" (f)

When we discover new objects, continues Asellius, we must give them some name, by which they may be characterized; the appellation of lacteal vessels he thought was best suited to these.

Some cotemporary anatomists, jealous of his success, have refused him the honour of this discovery; but upon the whole, he has few antagonists to combat, except Hoffman (g) and Harvey (h).

(f) Vide Asel. de Lactibus. p. 30. Ludg. Batav. 1640.

(g) Apol. pro Gal. Lib. iii. Cap. 133.

(h) De Gen. Anim. p. 195.

Rolfinckius (*i*) demonstrated these vessels soon after Asellius.

Asellius tells us, that the structure of the lacteals is similar to that of the veins, that their external surface is smooth and polished, and that the internal has several membranous productions, which perform the office of valves; he afterwards speaks more clearly on this subject (*k*), "in his
" illud admiratione dignum, quod pluribus valvulis sive ostiolis interstincti
" sunt, five intercisi, quas ego valvulas &c. animadverti."

These valves are found, according to Asellius, not only at the origin of the lacteals from the intestines, but in many other parts throughout their course. He says the lacteal vessels differ in their capacities, that they run more superficially than other vessels; and that they open from the cavities of the intestines, and principally from the jejunum.

Thus far the fortunate Asellius describes the vessels with perspicuity and accuracy; after which he deviates into error, and blends truth with falsehood, by adopting a mistake of Andernac's (*l*), which Vesalius, Columbus, and several other anatomists had corrected. He places a gland in the middle of the mesentery, which he calls the pancreas. He says that this gland is situated like the veins, between the duplicature of the mesentery, that it is cellular, and that in these cells the vessels run round like a labyrinth; large trunks of vessels pass on, which encircling the branches of the vena portarum, penetrate into the vena cava. Some of them, he says, open into the vena portarum; the greater number insinuate themselves into the liver, ramify as they penetrate into the substance of the gland, and become at last so small and thin that they resemble hairs. These are the only remarkable circumstances we find in the work of Asellius. Had he known the thoracic duct, which was seen before him by Eustachius, he would have traced the chyle and vessels, not into the liver, but into the left subclavian vein.

Veslingius (*m*) has described, and first given us a figure of the human lacteals; but it is evident, from the examination of his plate, that it is an imagined figure, and copied from Asellius. The lacteals here represented, are very similar to those of a dog, the small trunks which come from the

(*i*) Vide Elem. Phys. Tom. vii. p. 202.

(*k*) Asel. de Lact. P. 52.

(*l*) Portal. Hist. d'Anat. & Chir. Tom 1. p. 345.

(*m*) Vesling, Syntag. Anat. Tab. II. Fig. 1.

intestines pass into larger ones on the mesentery of this animal. Instead of the lacteals being represented as directing their course to the numerous conglobate glands in the mesentery, (an invariable rule in the human subject) he carries them away to the human pancreas, shews them going into the inferior, and issuing from the superior edge of that gland; after which they are delineated as forming four trunks nearly of the same size; each trunk is made to bifurcate, and to enter into the liver at the portæ.

Veslingius has not represented in his figure, a single lacteal gland on the mesentery; and the more we consider this plate, the more we shall be convinced of its being an imagined figure. He has connected the lacteals with the pancreas, because Asellius had demonstrated in his plate, and said in his descriptions, that the lacteals went on to a large gland in the root of the mesentery, which he took for the pancreas of the animal. Asellius too thought they went to the liver, therefore Veslingius has connected his imagined lacteals with this gland. In his description of the vessels he says, "*Quibus accensendi sunt meatus illi chylum deferentes, quod ab ejus albicante colore tinctos venas lacteas appellat princeps eorum observator. Sed hi, quemadmodum à sumpto cibo, aperto animantium abdomine evidenter in conspectum veniunt, transparente per tenues tunicas nivei candoris succo; ita iisdem vita defunctis, chylique distributione cessante subtilium nervulorum, membranarumque specie, sensum eorum fugiunt.*"

"*Nec rarò tamen evenire solet, ut per intemperantiam hominum affluente per tot vasa omnium humorum copiâ, impletis supra modum glandulis, porisque chylum deferentibus obstructis, aut compressis, publica coctio detrimenta plurima patiatur: aut colluvie corruptorum, putrescentiumque succorum factâ, lentarum febrium & contumacium affectuum aliorum, in mesenterio stabulum deprehendatur.*"

"*Amplitudo ejus in obesità ingens; adaucta largiter pinguedinis mole, quæ frigidum, siccumque membranarum temperamentum, caloris uberioris, ac humidi accessione lenit. Hærit circa supremam lumborum, tertiamque vertebram, nexu admodum firmo. Extremis verò suis, intestinorum volumina colligit, atque undique sibi devincit.*"

"*PANCREAS est pars abdominis glandulosa, chylo ulteriùs, attenuando, & depurgando, adeoque jecori, lenique preparando utilissima, antequam is*

nobiliore sanguinis veluti purpura imbuatur. Quemadmodum enim sanguinem ipsum, qui fœtui alimento futurus, aut pro generatione ejusdem in semen transmutandus est, per varios quasi gradus, ad perfectionem sibi debitam natura deducit: ita quem in sanguinem convertere conatur succum, non in ore tantum alterat, in ventriculo concoquit, fœcum admistorum onere sublevat; sed in hoc viscerum calidiorum vestibulo, exactius quoque digerit, & ab acribus, falsisque fordibus vindicat. Itaque chylo, dum is spirante adhuc animali distribuitur, copiosè perfusum est pancreas eundemque cuspidis cultri fauciatum largiter effundit.

Suscipit chylum, susceptumque jecori subministrat, non per venas ullas, à porta descendentes, aut arterias; sed singulares ductus, quos ob similitudinem aliquam, tum conformationis, tum distributionis, *venas* Asellius nuncupavit, easque *lacteas*, ut superius memini, quod candidum liquoris admissi colorem exprimant. Longa autem sunt, & teretia vascula, ex membrana tenui producta, à pancreate sursum, circa descendens venæ portæ truncum ad jecur; deorsum verò ad intestina, minutissimis propaginibus dispersa. Valvulis prædita sunt suscepti liquoris ad intestina regressum impredientibus. Ad lienem eadem pertingere, nexus potius pancreatis cum illo suadere potuit; quàm perspecta hætenus meatuum manifestorum communio; quos & delitescere necesse est, cum aqueam chyli portionem, adeoque non coloratam lieni suppenditent.

Origo venarum lactearum, haud aliunde rectius, quàm à pancreate ducitur. Arterias enim, venasque rubentes, quibus illæ compositione officioque cognatæ sunt, non à furculis, sed ampliore truncorum fundamento natura protendit. Idem in lacteis fieri vero similis est, quarum fundamentum, & amplitudo omnis circa pancreas; ramuli verò extremi in jecore, atque intestinis. Colligere easdem in communem aliquem truncum, ob latitudinem pancreatis insignem, divino conditori non placuit; qui satis habuit, quemadmodum fit in nervis ad sensuum organa perducendis, illas à communi quadam scaturigine, sed distinctis intervallis emittere."

It appears that Veslingius knew nothing more than Asellius had discovered in quadrupeds; but wishing to go beyond Asellius, who had not been able to see the human lacteals, he produced this erroneous imaginary figure, by connecting the lacteals of a dog to the human pancreas and liver. It is a matter of extreme surprise, that this circumstance has been overlooked

looked by the illustrious Haller, when he observes, that Veslingius is the first who has given a figure of the human lacteal vessels.

The existence of the lacteal vessels, discovered by Asellius, was denied by the immortal Harvey, C. Hoffman, Riolan and others. Harvey (*n*) asserts, that the absorption of the chyle is effected by the veins of the intestines. The lacteals were seen soon after by Rolfinckius, in 1626; by M. A. Severinus, in 1630; by Wormius, in 1630, or 1631; and by Hildanus, in 1632 (*o*).

During this century, the existence of the lacteals appears to have been much doubted (*p*), until Pecquet (*q*) discovered the thoracic duct, by first observing a white opaque fluid, which he thought resembled the chyle, upon opening the right side of the heart of a dog. From this accidental circumstance, he was induced to trace the lacteals more particularly in these animals than Asellius had done: he followed them into the receptaculum chyli, and discovered the thoracic duct, with the terminations of it, in the venous system. This discovery was made, according to Haller (*r*), in the year 1649.

Veslingius (*s*) is said to have seen a large chyloferous vessel, passing up the cavity of the chest; but it does not appear that he had any idea of its being the trunk of the system: nor is the account he gives of it so clear as that by Eustachius. About the same time Olaus Rudbeck (*t*) saw the duct, and traced it in the human subject, towards the year 1654; and in the same year Thomas Bartholin dissected it in the human subject, as well as Diemerbroeck and Langius (*u*). Soon after the duct and lacteals were seen in the human species by a great number of anatomists, and in many quadrupeds, and even in some cetaceous animals.

About the year 1652, Dr. Jolyffe and Thomas Bartholin, discovered the remaining part of the system. Thus, a complete and new system of

(*n*) Vide Gener. Animal. p. 165.

(*o*) Elem. Phys. Tom. vii. p. 202.

(*p*) Ibid.

(*q*) Ibid. p. 203, 204.

(*r*) Ibid. p. 204.

(*s*) Ibid. p. 203.

(*t*) Ibid. p. 204.

(*u*) Ibid. p. 204.

vessels,

vessels, carrying fluids different from blood, was found to exist in the human body. For a more particular account of these discoveries, I refer the reader to the illustrious Haller (*w*), Hewson (*x*), and Portal (*y*), where he will find ample information.

Let us now proceed to describe the structure of the membranes which compose the coats of the lacteals; which are exactly similar to those of the lymphatics. It has been supposed, on account of the transparency and tenuity of the coats of these vessels, that it is impossible to determine their number and structure. I flatter myself, however, that I can venture to speak decisively to those two points. That there is a dense internal coat, which is smooth and polished on the inside, is evident to all anatomists; it is connected by a reticular substance on its outside, to the internal surface of the middle coat. This fine internal membrane prevents the transudation of the lymph and chyle, and produces certain duplicatures internally, which form the valves, found in every part of this system; and it is exactly similar to the internal coat of the veins. The second coat, I apprehend, consists chiefly of muscular fibres running in every possible direction; the greater number take the circular direction, and surround the internal membrane. These circular muscular fibres I have seen in the thoracic duct of the horse; in which animal the duct is as large as the little finger. We can also separate an outer coat, which is made of a membrane similar to the pleura, or peritoneum; after this we distinguish the fibrous middle coat, particularly the circular fibres, and under that the internal coat. The experiment will succeed best if the thoracic duct of this animal, or a large lacteal from the great intestines, be drawn over a glass tube, of such a size as to require the vessel to be somewhat dilated, in order that it may pass over the tube. By this contrivance, I have seen the external coat slit in the longitudinal direction, while the vessel was on the tube, and the middle muscular coat, as well as the internal coat, have been thus dis-

(*w*) Vide Hal. Element. Phys. Tom. i. p. 156.

(*x*) Hewson's Experimental Inquiries, part ii. ch. i.

(*y*) Portal Hist. d'Anat. & Chir. Tom. vi. p. 288.

tinguished (z). Hence arises the greater necessity for those valves which are found in every part of this system in the human subject, in the more perfect animals, as they are called by anatomists; and even in the turtle, among the class of amphibia.

The coats of these vessels, in respect to number and structure, appear to me to be analogous to those of the arteries and veins. In these last I can distinguish in many animals, particularly in the turtle, the three coats I have described, by making a transverse section of any large artery or vein near the heart of this animal, and even in some of these vessels that are at a distance from the heart. In the spermatic arteries, in the gravid uterus of the cow, and in some arteries of the human body, I have for a long time exhibited such specimens in my anatomical courses of lectures. I can likewise demonstrate, that the external and internal coats of the vessels are chiefly composed of the surrounding reticular substance compacted; and shall take this opportunity of observing, that the pleura and peritoneum are formed in the same manner. In some parts of the last mentioned membrane, I have long since exhibited in my lectures a fibrous appearance, evidently discernible by the naked eye. From a number of experiments indeed, which I have lately made in the human body, but particularly in the dissection of large animals, such as the horse, ass, &c. I am more strongly convinced that Haller has great reason to assert, that the reticular membrane is the basis, perhaps, of the whole of the fibres of animal bodies;—but a further discussion of this point at present, would be foreign to my purpose.

The coats of these vessels are much stronger than those of arteries and veins; this is evident from injecting them with quicksilver. They will sustain a greater column of this fluid than arteries and veins of the same size, or perhaps four times as large, notwithstanding their thinness and

(z) I have frequently exposed large lymphatic vessels in the necks of living dogs, in the course of the internal jugular veins, and having disengaged them perfectly by dissection, from all surrounding muscles and vessels, have pressed them with my fingers to stop the progress of the lymph; upon which they have become swollen, turgid, and knotted at their valves: but upon removing my fingers, still keeping the vessel clear from the adjacent parts, to prevent any lateral pressure, I have seen it contract so powerfully, that its cavity was completely closed.

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transparency: a circumstance, which, I apprehend, depends on their density. They are undoubtedly the most irritable of any system of vessels in animal bodies; this is evident from the exertion of their contractile powers, for they are generally found empty in the dead subject, and from experiments instituted on living bodies. There is a greater necessity for muscular power in the absorbent system of vessels, than in any other, because they are not continued from the arteries as the veins are, and therefore appear to want the *vis a tergo*. Even in the silk-worm, and many other caterpillars, I have seen the lacteals loaded with white chyle, and have observed a knotted, or vesiculated appearance in them, which is the indication of the valves.

It is said by the indefatigable Hewson, that there are either no valves in the absorbent vessels of fishes, or that the valves give way to the injection, as it will pass from trunk to branch in these animals. This I have constantly found by injecting their absorbent system, both in the flat fish, as the skate, and in the spinous, as the cod. It is probable that this difference may be owing to the circumstance of their not breathing air, and not to their residing in water; as I find by dissection, that the turtle, the whale class, and the seal kind, have valves in their lymphatic system. All these animals are provided with lungs, and consequently breathe air.

The valves of the absorbent vessels are made by duplicatures of the internal coat; they are of the crescent form, exactly like those in the veins, and are generally formed in pairs, except where a small vessel is inserted into a larger; in which case there is no necessity for two. Nature therefore places a single crescent over the orifice: the openings of the absorbent system into the venous are guarded in the same manner, and the retrograde motion of the fluid is prevented.

The uses of the valves in the absorbent system, so far as we have discovered, are to sustain the weight of the column of fluid above the valve, and prevent the pressure of it on the fluid below, to impede the retrograde motion of the lymph and chyle, and consequently to forward its progression towards the venous system and heart; for as it is impossible that the chyle and lymph can pass backwards, on account of their being resisted by the valves, it follows, that the muscular power of the vessel, assisted by the collateral pressure produced by respiration, and by the adjacent muscles and arteries will impel the fluid towards the heart.

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We shall next consider the manner in which these vessels first perform absorption. I am inclined to think, from analogy, that this is effected by capillary attraction. In the human eye, for instance, we have a fluid secreted to wash extraneous matter from the external surface of the cornea, and keep it clear for the purpose of vision: the fluid, when it has performed this office, is taken up by the puncta lachrymalia, and carried into the nose; these capillary tubes are kept constantly open to answer this purpose, thus affording us a most beautiful example of absorption taking place from capillary attraction.

It has been discovered by Cotunnus(a), that the cavities of some of the internal parts of the ear, such as the semicircular canals and cochlea, are filled with a fluid, which is secreted by the internal membrane or periotteum; and that there are two capillary orifices, which he calls aquæ ductus vestibuli, & cochleæ, to absorb this fluid. According to the present professor Meckel, these orifices convey the fluid, to the lymphatic vessels, upon the dura mater; which afterwards communicate with the sinusses of the same membrane: this appears to be effected by capillary attraction. In order to produce absorption in the lymphatic system, it is necessary that the orifices of the vessels, during this action, should be kept constantly open; this may be accomplished by a derivation of blood to the villi of the intestines. Thus the blood conveyed to the coats of the absorbent vessels, producing a species of erection in the villi of the intestines, may keep the orifices of the lacteal vessels in the villi open; and as long as the derivation continues, the fluid will rise in the vessel by capillary attraction. When it has got into the vessel, it cannot pass back again, on account of the resistance made by the valves; absorption will therefore continue as long as the orifices are kept open, provided they be in contact with the fluid.

The solids of animal bodies are equally capable of being absorbed, as the fluids. This circumstance has been first asserted, and demonstrated by Mr. John Hunter, and taught publicly in his lectures on surgery, for several years; particularly in his lectures on ulceration in general, exfoliation, and other diseases of bone, &c.

(a) Vide Cotunnus de Aqueduct. Auris Humanæ.

The thoracic duct was found full of calcareous earth, by Mr. Cheston (*b*) of Gloucester, in a man who had a *spina ventosa* on the *os ilium*, so that the cavity of the duct was totally obstructed, for a considerable length, with ossific matter, and would not suffer air to pass upon endeavouring to inflate it from the part below the obstruction, to the part above. We have in this case an instance of calcareous matter being absorbed, and found in the trunk of the lymphatic system: from which some persons have inconsiderately concluded, the man in this case being apparently well nourished, that the lacteals, or thoracic duct, had other terminations in the venous system, below the obstructed part; there being no other way to account for the nutrition received in this instance, when the duct was obstructed below the terminations at the angle between the jugular and subclavian vein. I am of opinion that the chyle and lymph, brought up by the thoracic duct, to the part immediately below the obstruction, were conveyed by the collateral anastomosing branches, to that portion of the duct above the obstructed part. These branches nature has given in greater plenty in the absorbent system, than in the arteries or veins; which I shall prove by direct experiments in the course of the work.

If an animal be fed with madder, it is well known that the earth of the bones will be strongly dyed, of a red colour, by the madder; and, as far as we yet know, no other part of the animal, except the earth of the bone, will be affected. If a calculus be formed in the urinary bladder of the animal, when the bones are coloured by the madder, which can be produced by the introduction of any extraneous substance into that organ; the earth which composes the calculus will be of a red colour, similar to that of the dyed bones. If we suspend for a time the feeding of the animal with madder, and then feed him again on the same substance, and proceed alternately in this manner; upon cutting the stone through, either by a perpendicular, or horizontal section, streaks of red will be found intermixed with others exhibiting the ordinary colour of the urinary calculus. This phenomenon cannot be otherwise explained than by supposing the earth of the bone to be absorbed by the lymphatics, and by them con-

(*b*) See Phil. Transact. Vol. lxx. part. ii. p. 323.

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veyed into the sanguiferous system; where being secreted by the emulgent arteries from the blood, with the earth of the urine, it is afterwards attracted by the nucleus introduced into the bladder. Some years ago, when from observing several phenomena in the human body, the idea first suggested itself to me, that the earth of the bone was continually changing, by the deposition of new matter, and absorption of the old; I had a conversation on this subject with Mr. J. Hunter, who informed me that he had fed himself with madder. I immediately asked him, whether he had observed that the earth of his urine was tinged by the madder: to which he answered, that the earth attracted by the sides of the vessel, in which the urine was made, was of a red colour.

In the *mollities ossium* likewise; a disease, the cause of which has not been well understood till of late: it is probable that the calcareous earth of the bone is absorbed, and carried out of the body, by the action of the kidneys, in the secretion of the urine. It has been observed by the late Mr. Thompson, of the London Hospital, in the case of James Stevenson (c); "That his urine, for the two first years of his illness, generally deposited a whitish sediment; which, upon evaporation, became like mortar, and he voided three or four small jagged stones sometime after a complaint in his loins." From this account we have every reason to believe, that the softness and want of stability in the bones of this subject, were occasioned by the absorption of the calcareous earth, by the lymphatic vessels in the bones. He was first taken ill in 1766, and in November 1768, two years after, his bones began to break under him; and the greater part of the calcareous earth being absorbed, the solidity of the bones was destroyed. It is scarce possible to obtain a more evident proof of the absorption of solids, by the lymphatic system, than this. We cannot indeed have any adequate idea of the exfoliation, and of most of the diseases of bones, of the formation of bone, or of the alteration in its appearance, which is continually taking place, from the earliest state of infancy, till the completion of the adult age; nor can we form any conception of the growth of the teeth, and of the changes in the alveolar processes of the jaws, particu-

(c) See Medical Observations and Inquiries, Vol. v. p. 266, and 267.

larly in the shedding of the teeth, the evanescence of the old sockets, and the production of the new; or account for ulceration itself, unless we admit that the solids are capable of being absorbed: for nature can as easily remove parts, as form them. In a word, there are many phænomena in animal bodies, which appear to be utterly inexplicable, without this circumstance.

An opinion has been generally entertained, that the orifices of the lacteals, which open on the villose coat of the intestines, are too small to be viewed by the best microscopes: I am not surpris'd at this, when I consider that their large branches, and even their trunks, are not to be seen, unless loaded with chyle, by anatomists themselves; except they are very conversant with this system. The first anatomist who has demonstrated their origin, from the villose coat of the intestines, is Lieberkühn, one of the best microscopic observers who ever existed; he has given a very ample description of them, with a plate engraved by the famous Lionet, in that most ample and elaborate dissertation, which he published in the year 1744. This work I have re-published with the Author's Life: the dissertations it contains, which may be considered as master pieces in the science, are little known, and exceeding scarce in this country.

In page 2, section ii, he says, "*(d)* Ad quemvis villum ex vasis majoribus
" tunicæ vasculosæ procedit

" 1. Ramusculus vasis lactei valvulis munitus.

" 2. Rami arteriolarum.

" 3. Venula quædam.

" 4. Nervus.

" 1^{mo}. Vidi in cadaveribus, lacte copioso paulo ante mortem nutritis,
" vitioque pulmonum & infarctu glandularum mesentericarum extinctis,
" vasa lactea caeco repleta, & quidem longe majori copia, quam ipsa vasa
" sanguifera, quæ simul cera viridi & rubra impleveram: nec lactea hæc
" tantum in mesenterio vidi, quod sæpius accidit, sed in ipsa etiam tunica
" intestinorum vasculosa.

(d) Vide Joannis Lieberkuhn, de Fabrica & Actione, &c. p. 2, in Dissertationibus quatuor à me editis Lond. 1782.

" Servo

“ Servo adhuc in liquore partem mesenterii infantis proxime ad intestini
 “ tubum abscissam, in qua tria hæc vasorum genera videre licet distinctissime.
 “ Villosam nimirum cultro acutissimo a vasculosa exacte separavi, portionem
 “ culam deinde ejus, supra annulum metallicum extensam, ea sede, qua
 “ illi cohæserat, microscopio examinavi: nactus sic opportunitatem exop-
 “ tatissimam videndi, ac discendi, ad singulum villum accedere ramum tan-
 “ tummodo unum vasis lactei, valvulis, æque ac vasa lactea majora muni-
 “ tum, lacte turgentem & exinde propendentem.

“ Ratio quare in ejusmodi corporibus vasa lactea distinctius, quam in aliis,
 “ videantur, facile patet. Quum enim glandulæ mesenterii obstructæ serum
 “ non nisi ægre transmittant, & huic in pulmonibus quoque resistentia ma-
 “ jor nascatur, caseoso crassamento infarcentur omnia vasa lactea tunica
 “ vasculosa, ad prima eorum principia usque. Moribundis aliquoties, ubi
 “ hæ conditiones aderant, lac copiose potandum dedi, & fere semper suc-
 “ cessit experimentum.

“ 2do. Ut plurimum ex ramo arterioso & venoso tunica vasculosa, qui
 “ villo proximi erant, plures arteriolæ, at una tantum vena, materie ce-
 “ racea plena accedebant ad villum; aliquando tamen plures etiam venulas
 “ deprehendi.

“ Raro autem contigit ut, in eodem villo, arterias intrantes in villum
 “ alio colore, alio autem venam, impletas conspicerem; licet trecentis mi-
 “ nimum vicibus arteriam mesentericam alio colore tincta materie, alio
 “ autem venam implevissem: via enim ex arteriis in venam nimis brevis
 “ est, ita ut vel ex hac in illam, vel ex illa in hanc, materies facillime
 “ eat, redeatque.

“ 4. Nervos ad villos accedere nemo negabit; nec eorum in his existentia
 “ alia demonstratione egere videtur, quam quæ ab acutissimo intestinorum
 “ sensu & dolore depromitur. In vasculosa demonstrari adhuc quidem ner-
 “ vuli possunt, & microscopiis filamenta quædam a vasis distincta cernun-
 “ tur; sed quomodo in villosam migrent, & in hac terminentur, quis de-
 “ terminaverit?

“ Ramusculus vasis lactei extenditur in ampullulam vel vesiculam ovulo
 “ haud absimilem, in cujus apice foraminulum quoddam exiguum micro-
 “ scopio detegitur.

“ Inveni villos in partibus quibusdam intestinorum (memoratorum) lacte-
 “ caseoso

“ caseoso infarctos turgere. Vidi, separata tunica vasculosa, in fede vil-
 “ losæ hanc respiciente, lacteum abire in ampullulam caseo plenam. Si
 “ quis vero foraminulum in apice hujus ampullulæ invenire velit, ei ne-
 “ cessum est, ut portiunculam intestini, cujus villorum cava distenta sunt
 “ lacte, & mucus intestinalis nondum deterfus, supra annulum metallicum
 “ parumper absque vi facta expandat, tum immittat in lagenulam vitream
 “ aqua plenam, & microscopio objiciat.

“ Quod autem unum saltem adsit foraminulum in cujusvis ampullulæ
 “ apice, certo examine mihi constat: interdum tamen, licet rarissime, plura,
 “ ut in papillis mammarum, vidisse memini. Nec ratio latet, quare in lacte
 “ turgidis villis foraminula hæc tantum observentur. Scilicet dilatato villo
 “ orificia isthæc exigua quoque dilantantur. Idem fit, si mucus intra villos
 “ relinquatur, & pars intestini supra annulum extenditur: quum enim hic
 “ mucus cum villis cohæreat, horum separatio fieri nequit quin latera fo-
 “ raminiolorum ab invicem diducantur.

“ Supra hanc vesiculam rami arteriarum ad apicem ejus usque decur-
 “ rentes, se dividunt in quam plurimos ramulos minores; ita ut dimidiam
 “ ejus superficiem serpentinis vasculis tegant.

“ Hæc sic se habere in preparatis nitidissimis microscopii ope cuivis de-
 “ monstrare possum. Abscidi nempe portiunculam intestini, cujus villi op-
 “ time impleti erant, eamque immisi in lagenulam vitream ex tubo ovali
 “ paratam & spiritu vini diluto plenam, quam hermetice sigillatam conservo;
 “ ut dubitantem quemvis, ipsa autopsia, quandocunque libuerit, convincere
 “ valeam.

“ (e) Nonnulli autem rami arteriarum & venularum descriptarum, trun-
 “ culis his suis longe minores, perforant bullulam lactei & in hanc apertis
 “ osculis hiant.

“ Impleo in arteriam mesentericam materiem ceraceam tenaciorem, ita
 “ ut redeat per venam mesentericam sat magna quantitate. Examino dein
 “ microscopio quam plurimos villos: invenio in omnibus non modo distenta
 “ vascula, sed etiam turgere ampullulam lactei cera alba plenam. De-
 “ monstro & hoc præparatis.

(e) Vide Dissert. Lieberkuhn, ut antea, p. 9.

“ (f) Uno

“(f) Uno tandem experimento, ast quod irritō conatu sapius repetendum erit, si quis accuratius adhuc videre cupiat, sequenti modo procedat. Sumat intestini partem parvam, ad quam notabilis ramus arteriæ & venæ accedit; hanc intercipiat intra annulos duos metallicos, qui e lateribus connexi ad se invicem accedere conantur: ibi autem, ubi arteria ad hanc partem accedit, in uno annulorum crenulam faciat, ita ut arteria libera, nec compressa, ad hanc partem accedere queat: tunc huic arteriæ adliget tubulum exiguum, & huic canalem aliquot pedes longum, quem in situ ab horizontali non multum abscedente constitutum, materia non facile consistente, bene colorata, impleat: exponat dein partem intestini microscopio, & attente observando villos, tubum successive è situ horizontali ad perpendicularem dirigat: sic videbit jucundo spectaculo,

“1^{mo}. Materiem intrare per arterias in villum.

“2. Dare quam plurimos ramos serpentino modo decurrentes.

“3. Ex his pergere ad totidem venulas.

“4. Ex his ad venam ex villo exeuntem.

“5. Tunc tandem per alia vascula minora intrare in ampullulam lactei distendere hanc, & demum,

“6. Exire per foramen in apice hujus patens.

“Ampullula vasis lactei, hætenus descripta, intus repleta est substantia spongiosa.

“Infles per arteriam vel venam mesentericam, partem intestini intra duos annulos metallicos interceptam, aditu arteriæ vel venæ libero manente, ut in experimento §. præcedentis; penetrabit aer per vasa descripta in cavum villorum, distendet hos, & ex his per foraminula in apice bullularum exhibit. Si cessas flando, collabuntur iterum villi; sed si continuas, quod applicatione follis facile fit, donec exsiccaveris, distenti manebunt. Tunc cultro rasorio acutissimo finde villos, & videbis microscopio eorum cavum impletum esse materie quadam spongiosa vel cellulosa.”

In this quotation from Lieberkühn, we have a most accurate description of the minute anatomical structure of the villi of the intestines, of the

(f) Vide Dissert. Anat. Lieb. p. 11. §. II.

M

beginnings

beginnings of the lacteal vessels from the internal surface of the villose coat, and even of their orifices; and there is no doubt that this excellent microscopic observer not only saw, but was likewise the first who discovered them. As he did not make the discovery by chance, he deserves much praise for his sagacity in previously preparing the vessels, in living subjects, by giving them milk just before they expired, and for the great pains he took in making experiments, and injecting them after death.

It is a matter of surprise that greater attention has not been paid by anatomists to this discovery of Lieberkühn's, for I do not find that any of my cotemporaries, except one (g) have seen the ampullulæ. Mr. Hewson (h) denies the existence of them; he is of opinion that they are not found in birds, fishes, and amphibious animals; for these classes of animals have net-works of lacteals, as well as of arteries and veins, on the villi of their intestines: he therefore concludes it to be most probable that the lacteal vessels have the same structure in the human subject. He says, "he can clearly shew the orifices of the lacteals on the extremities of the villi, where there appear, (as Lieberkühn has described) sometimes one, and sometimes more orifices: that when the preparation was not injected to a great degree of minuteness, the villi appeared exactly as Lieberkühn had figured them, and when they were examined with the microscope, no orifices could be observed, each of them appearing to have a smooth edge; in some part of the ileon, where the injection had run more minutely, the villi appeared erected; and instead of being broad and thin, were more round and cylindrical, and their extremities seemed spongy and porous, while the sides of the villi were perfectly smooth and uniform." Mr. Hewson thinks "as in these preparations the orifices only appeared when the villi were completely erected, that this circumstance points out the use of the villi," he says "on repeatedly examining them, he observed the pores or orifices very distinct and empty."

The next anatomist who has described the ampullulæ, is the ingenious Mr. Cruikshank. In his letter to Mr. Clare he says, that he found the

(g) Mr. Cruikshank, Lecturer of Anatomy and Surgery, London. See Mr. Cruikshank's letter to Mr. Clare, published in an Essay on the Cure of Abscesses by Caustic, &c. &c. by Peter Clare, Surgeon, 2d. Edition in 8vo. 1779, p. 57.

(h) See Experimental Inquiries into the Lymphatic System by W. Hewson, p. 182.

ampullulæ

ampullulæ filled with chyle, in a subject which died suddenly; that he applied the microscope, and saw the absorbent orifices of the lacteals on the ampullulæ, and shewed this appearance to the late Dr. W. Hunter and to Dr. John Jebb, who were likewise of opinion that they discerned them. I have also found the ampullulæ in the human subject, and have several preparations of them in my possession: they answer the description which Lieberkühn has given of them, as well as that of Mr. Cruikshank. I have seen them repeatedly of late years, in every subject where the lacteals were found to contain chyle in the dead body; in all these, when I have examined the villose coat with attention, I have discovered the ampullulæ. I have seen them of different forms, most commonly bulbous, as represented by Lieberkühn (*i*), I have also seen a number of ampullulæ filled with chyle, sometimes forming clusters, as represented in Plate I. of this work fig. 3. while in other parts of the small intestines, I have found them solitary, and projecting beyond the villi, as may be seen in several of the figures in Plate I. This answers exactly to the description of the accurate Lieberkühn (*k*) *Lacte turgentem et exinde propendentem*. I have examined many of these preparations by putting them in water in a watch glass, or in glass tubes, and have applied the microscope, viewing them at one time, as opaque, at another as transparent objects.

When I have observed them in clusters, it sometimes appeared to me, that the orifices were conspicuous in their extreme points, which Lieberkühn has called, speaking of a single ampullula, (*l*) *foraminula in apice*. When I examined the solitary ampullulæ, their orifices were not to be discerned, so that it was a matter of doubt with me, whether the appearance of orifices in the clustered lacteals, was not that of the interstices between the different ampullulæ.

When these experiments were made, I was unacquainted with (*m*) Lieberkühn's method of searching for the ampullulæ, and used to wash away

(*i*) Vide Dissert. Lieb. ut antea Tab. I. Icon 2.

(*k*) Ibid. p. 3.

(*l*) Ibid. p. 13.

(*m*) Ibid. p. 5.

the mucus. My want of success might therefore possibly arise from this circumstance; and I have not since had an opportunity of meeting with a proper subject, to make the experiment in the manner recommended by that anatomist.

The ampullulae with their orifices, are then to be considered, as the beginnings of the lacteal vessels; as parts capable of being erected by having a greater quantity of blood derived to the vessels of their coats, in consequence of their being stimulated either by the chyle, or by the fluids subservient to digestion; this occasions, as we imagine, a derivation of blood to them, and causes their orifices to be kept rigidly open, and the chyle is thus drawn into them by capillary attraction.

The lacteal vessel arising from the ampullula, I have frequently traced, from having found it loaded with chyle in some dead human subjects.

These incipient branches of the lacteals arising from the ampullulae are soon joined to those, which are represented in Plate II. fig. 1. 2. 3. these lead on, and are continued into those trunks which will admit of the insertion of pipes, and may be injected with quicksilver, as they appear in Plate III. IV. and V.

Not having had a satisfactory view of the orifices of the ampullulae, I have judged it necessary, in order to render this work as complete as possible, to give a figure of them, taken from Lieberkühn.

In the first plate of this work there are seven different figures representing the ampullulae, and there are no numbers affixed to the different objects, that the plate might not be disfigured: in order to supply this deficiency, it may be noticed that the objects are to be reckoned from the left to the right in horizontal lines, beginning with the upper row. In figure 1. several of these ampullulae are represented of their natural size, upon the internal surface of the villose coat of a portion of intestinum duodenum of the human subject. In this as well as in the other figures represented in this plate, they were loaded with chyle, and projected beyond the villi; some of them were bulbous or vesiculated (*n*) *vesiculam*

(*n*) Vide Differt. Anat. Lieb. p. 4.

ovulo haud abfimilem,) while others, were of a cylindrical form, a difference which depends upon their being more or less turgid with chyle; for in proportion as they are distended, they will approach to the elliptical or globular form. This is rendered evident by the circumstance of the lacteal vessels, in other parts of the intestines, assuming a cylindrical figure, when they contain a small quantity of chyle, and by their becoming of a globular form, between each pair of valves, when much distended.

(o) In fig. 2. a portion of the lower part of the ileon is represented; one half of this portion of intestine is cut open to shew some solitary ampullulae on its villose coat. Upon that portion of the intestine which is entire, a part of a lacteal trunk distended with chyle is seen; it is one of those which run immediately under the peritoneal coat of the intestine, and which we are capable of injecting with quicksilver.

In fig. 3. in the middle of the object, a cluster of ampullulae is seen loaded with chyle; and several solitary ones, which were remarkably turgid and projected considerably beyond the villose surface, may be likewise discerned. The object consists of a portion of human ileon inverted, and the drawing was made from the preparations suspended by means of threads in glass bottles filled with proof malt spirits, so that these objects are represented rather larger than they are in nature, from their being magnified by the convexity of the bottles.

In fig. 4. two of the solitary ampullulae are seen as they appeared when magnified by the opaque microscope.

In fig. 5. the same ampullulae are exhibited of their natural size.

In fig. 6. a cluster of ampullulae is represented.

In fig. 7. the same is seen as it appeared when magnified; and in this, I thought, as well as the ingenious artist who made the drawing, that the orifices of the lacteals were conspicuous; but as we could not observe them in the solitary ampullulae, when viewed with the microscope, we entertained the same doubt with respect to their appearance, as was before expressed in page 37, of this work.

(o) Dissert. Anat. ut antea, p. 4.

N

The

The small figure in Plate II. which is taken from Lieberkühn, represents two ampullulæ which are remarkably turgid with chyle; a minute branch of a lacteal is seen arising from each ampullula, and the orifice in the extremity of the ampullula is distinctly seen, being rendered conspicuous in the figure, by the speck of shadow on the point. Several other orifices are also visible on the sides of the ampullulæ, and which are represented by specks of light. (*p*) Lieberkühn informs us that he injected arteries and veins upon the ampullulæ; he observes that the finer branches are spread over them; he saw the fluid injection pass from thence into their cavities, (*q*) *apertis osculis hiant*; and run out by the orifice at the extremity; (*r*) *exire per foramen in apice hujus patens*. He is likewise of opinion that these cavities are filled with a (*f*) cellular or spongy substance.

There is nothing more to be found in Lieberkühn respecting the structure of the ampullulæ.

Let us now proceed to trace and describe every thing that is remarkable in these vessels from this origin to their terminations in the thoracic duct.

I have been fortunate enough to discover the lacteals much nearer to these beginnings than they have been hitherto described.

Many years ago, when a student at the Westminster Hospital, I found, in persons who had died with ulcers on the villose coat of the small intestines, the lacteal trunks under the peritoneal coat, much more conspicuous, than in other subjects; and I injected them as well as some mesenteric glands of the first order with quicksilver, at that period.

I imagined myself to have been the first person since the time of Nuck, who had injected the human lacteal vessels, and was therefore much pleased with my success; but I soon learned from some of my anatomical friends that the present Professor Monro had injected them, when he was studying at Berlin, with the late Professor Meckel; and this prepa-

(*p*) Vide Lieberkühn, Dissert. Anat. p. 9. §. 6.

(*q*) Ibid. p. 9. §. 6.

(*r*) Ibid. p. 12. §. 7.

(*f*) Ibid. p. 13. §. 8.

ration is still in his possession. My late ingenious friend Mr. Hewson likewise informed me, when I mentioned this circumstance to him, that he had once filled them in the human subject. Accordingly, I met with a preparation of a human lacteal trunk injected from the intestine, to a gland of the first order, in Dr. Hunter's museum, when I went to reside with him as an assistant in anatomy, after the death of Mr. Hewson. Upon inquiry I found that this was the preparation which Mr. Hewson had mentioned to me; and it was the only specimen of the human lacteals injected, existing in England at that time. Mr. Hewson seems to have considered it as a matter of some difficulty to make such a preparation, since he says in his work on the lymphatic system, (t) "I have injected them with mercury even in the human subject."

When I examined the diseased intestinal canal before described, I observed the following very curious appearance in several different portions of the small intestines, which had been slit open and suspended in water, till the blood was soaked out of them. When the object was viewed as a transparent one, I saw great numbers of pellucid vessels running in the longitudinal direction of the intestine, and since that time, I have repeatedly seen the same appearance, and am happy in the opportunity it hath given me, of tracing the lacteals, and demonstrating them, from their beginnings, as described by Lieberkühn, to their larger trunks, and of investigating the complete course of these vessels. This could not have been done, without these preparations, for we cannot inject them so near their orifices.

As this appearance was extremely curious, and was found difficult of representation, I employed several draughtsmen to delineate it. My learned friend Dr. Antonio Scarpa Professor of Anatomy and Surgery at Pavia, who was at that time in London, was likewise so obliging as to make the drawing from which the third figure in Plate II. was engraved, and this is the most accurate of the three.

An anatomist to whom I shewed this appearance many years ago, was of opinion, that, it was produced by the interstices of the longitudinal

(t) See Experimental Inquiries into the Lymphatic System, p. 32.

muscular fibres of the small intestines; but if this were the fact, it would be in some degree evident in all subjects; and would be particularly visible in the intestines of those, in whom the muscular coat is strong; neither of which circumstances occurs. Besides, these vessels do not run parallel to each other, as the longitudinal muscular fibres of the small intestines do; nor do the latter fibres communicate or run into one another as the former; the opacity of the muscular fibres is likewise greater.

It is however needless to insist any longer upon this circumstance, since it is established beyond a doubt, by the existence of the valves, which may be plainly distinguished in some parts of the preparation; and by my having injected many of the trunks, which I have seen communicating with these vessels, nor should I have thought it necessary, to argue so fully upon this matter, if the gentleman above mentioned, had not been of a contrary opinion.

The branches I have just described, communicate with the absorbent trunks represented in Plate III. of this work, which are so large, that we are able to insert steel-pipes into them, and to inject them with quick-silver, which appears to have been first effected by (u) Nuck; the first anatomist also, who has given a figure from nature of the human lacteals.

(x) Duvernoi has likewise given us a very tolerable figure of a few lacteal trunks of the first order, which he found loaded with the chyle.

There is in (y) Bidloo, as well as in (z) Heister, a Plate of them, in which there is nothing material; and in (a) Cheselden one so extremely incorrect, that it certainly must have been drawn from imagination. There is also a Plate by Santorini, in which some of the human lacteals are figured, in that elegant work lately published in Italy, by Michael Girardi, Professor of Anatomy at Parma; but in this Plate there is nothing worthy

(u) Vide Nuck Adenographia p. 31. fig. 9. Ludg. Batav. apud. Sam. Luchtmans 1722. in 12mo.

(x) Duvernoi. Comm. Acad. Petropol. Tom. I. p. 269.

(y) Bidloo Tab. xxxix.

(z) Heister Compendium Anatomicum, Tab. II. fig. 8.

(a) Cheselden's Anatomy Plate XXIII. fig. 1. 5th. Edition.

of attention respecting the lacteals; these with the Plate by Veslingius, which was considered in a former part of this work, and Lieberkühn's which we have lately described, are the whole of the plates extant of the human lacteals; and of these there are none which are of any consequence except those of Nuck, Lieberkühn, and Duvernoi.

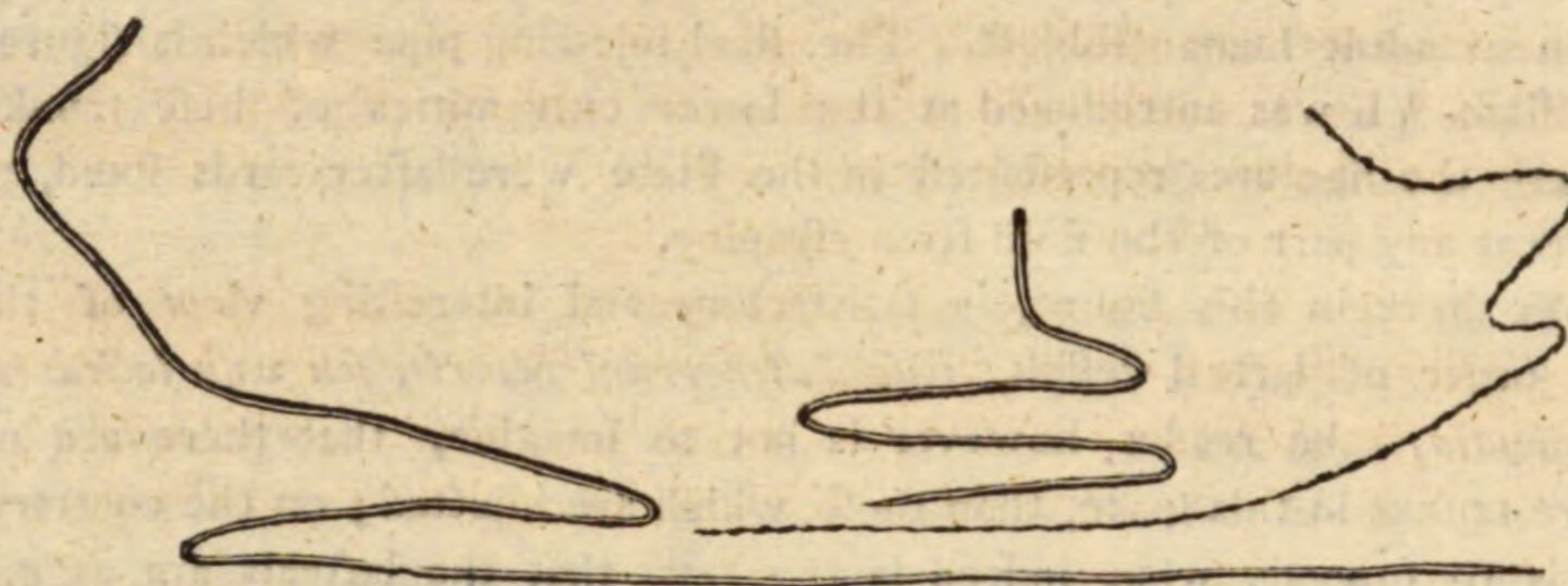
In the third Plate of this work, ten lacteal trunks are delineated, as they appeared in the fresh preparation after having been injected with quicksilver, and after the anterior layer of the peritoneum had been removed by dissection, to shew their course through the mesentery, and their connection with the first order of lacteal or mesenteric glands. The preparation consists of a portion of jejunum, with it's mesentery, from an adult human subject. The steel injecting pipe which is figured in Plate VI. was introduced at the lower extremities of these trunks, where the ligatures represented in the Plate were afterwards fixed, to prevent any part of the fluid from escaping.

We have in this figure, a satisfactory and interesting view of the first order of lacteal vessels, *vasa lactea primi generis, seu vasa lactea ingredientia*; the reader however is not to imagine, that there are no more trunks in this space, than those which are injected; on the contrary, he is to suppose, what indeed is the fact, that the lacteals are as numerous as the blood vessels; which can be proved in the turtle, porpoise, and many fishes, and even in some quadrupeds. In this Plate, we observe the trunks upon the intestinal canal running superficially and covered only with the peritoneum; we remark likewise, contrary to what we should have supposed from analogy, that the trunks upon the small intestines proceed in the longitudinal course of the canal, in a direction opposite to the course of the blood vessels and nerves.

This remarkable course of the lacteals on the intestines I have seen in all the classes of animals, where the intestinal canal is connected to a mesentery, as in the human subject; and it is noticed in the turtle by our immortal Hewson (b).

(b) See Experimental Inquiries into the Lymphatic System by W. Hewson, p. 80.

As this peculiarity is found to exist so universally in nature, it must certainly answer some general purpose in the animal œconomy, and I am more strongly inclined to this opinion, from observing that these vessels are serpentine, as may be discerned in many parts of this figure and also in Plate V. This I have seen more obviously in some human lacteals, and have also noted the same appearance in injecting those of the horse and ass. In the human subject I have always found, that the trunks of the lacteals on the intestine run on in the straight line for a very considerable way. In order to make this appearance more evident to the reader I have demonstrated it by the following lines (c).



The canal of these vessels is considerably lengthened, by this arrangement; the chyle too is detained much longer in its passage to the thoracic duct, and the blood; and the fluid of course is more highly elaborated; for it is a well known fact, that all the animal fluids undergo considerable changes, in passing through their vessels, and excretory ducts. The semen, for instance, is much altered in passing through that great length of seminal vessels found in the body of the testis, the epididymis, and the vas deferens. We may therefore suppose that the chyle is also very materially changed in its progress, and comes nearer to the nature of

(c) The Object on the left side of the Page is taken from a lacteal on the small intestine of the horse, the middle one from the same intestine of the human subject, and the one on the right from the small intestine of the ass.

blood,

blood, to make which it is destined; and it is probable, that there exists, not only in the coats of these vessels, but also in the lacteal glands, some power of producing this alteration, with the nature of which, we are yet unacquainted.

In this Plate we likewise observe, that the lacteal, where the trunk is rising from the intestine to pass on between the duplicature of the mesentery, forms an angle with that portion of it, which lies on the intestine; and this is one of the marks, by which we distinguish the lacteals.

The numerous valves found in every part of these vessels, are conspicuous, from the knotted, and in some places, the vesiculated appearance of them: their transparency, which depends upon the tenuity of their coats is likewise visible in this figure. The lacteals are also seen dividing into branches before they pass on to the glands; some trunks divide, on the mesentery near the intestine as may be seen in Plate IV, others run very close to the gland or glands before they ramify; but all of them separate into branches before they enter the glands; in this circumstance they agree with the lymphatic vessels.

Upon the upper part of this figure, four lacteal glands of the first order are seen, two of which are small, the other two much larger. The cells which are found in all parts of the substance, both of these, and of the lymphatic glands, in all the different animals I have examined, are here injected. I have observed, that the magnitude of the cells of these glands, as well as of those belonging to the lymphatics, differ, in proportion, to the size of the glands; being larger in the largest glands, as they are represented in the Plates. This circumstance will be most distinctly seen in Plate III.

To complete the description of this figure, it is only necessary to remark, that the vessels kept in shadow, which form a kind of background to the lacteals, are the arteries and veins, which were injected with red and blue in this preparation.

And here let me be permitted to return my grateful acknowledgements, to my learned friend Dr. Antonio Scarpa Professor of Anatomy and Surgery in the University of Pavia, for his very great attention,
in

in making the drawing, from which this figure was engraved, as well as that of fig. 3. in Plate II. of this work, and for his solicitous care in the management and correction of the Plate. The original preparation from which this Plate was made, is in the possession of Professor Scarpa to whom I presented it.

We have now traced the vessels from their orifices, through the mesentery, and to the first order of glands. The lacteals are to be considered, as performing the office of lymphatics to the intestines, as well as of lacteals, since the lymph in the interstices of these parts is absorbed by these vessels, and must of course be mixed with the chyle. I have thought proper to mention this, because some authors have spoken of lymphatic vessels on the intestines, independent of the lacteals; but these have been the offspring of their own imaginations.

In some subjects, the lacteals upon the intestines, will be found varicose, as in Tab. IV. where three lacteals upon the human jejunum are delineated from nature as they appeared when injected with quicksilver. The lacteals in this subject, a strong corpulent male of about forty years of age, were as remarkably varicose, as I ever remember to have seen them; but they lose this structure, soon after they emerge from the intestine. The middle lacteal in this Plate, is observed to break into four trunks, and forms a most beautiful appearance. Two other branches are seen passing into the lacteal trunk on the left side of the object; these three lacteals after ramifying, pass on to a gland on the mesentery, which they enter, and communicate with the cells, that are seen distended by the quicksilver with which they are injected. Three lacteals of the second order, *vasa lactea secundi generis, seu vasa lactea egredientia*, are also observed, emerging from the gland. The preparation consists of a portion of ileon, the lacteals are injected with quicksilver, and the part is dried, and represented semi-transparent, as it appeared to the artist, from being put into oil of turpentine.

Mr. (d) Hewson is of opinion that Nuck has represented the absorbent

(d) See Experimental Enquiries, Part II. by W. Hewson, P. 18.

vessels too varicose, making them to resemble chains of vesicles; but I have frequently seen this appearance in the human lacteals, as well as in many lymphatic vessels of the human subject, and other animals, and this is exemplified in the Plate I have just described.

The *vasa lactea primi generis*, or first order of lacteal vessels, do not appear to have any considerable lateral communications with each other, since we are able to discover none by our injections; and the division of the vessel, into a number of branches, before it enters the gland or glands, seems to me to compensate for the want of lateral communications. In the turtle and some fishes there are numerous lateral anastomoses.

The lacteal or mesenteric glands, as I have noticed in a former part of this work contain, minute cells, (e) into these the first order of lacteals enter, and convey the chyle, and from them, the second order, or *vasa lactea egredientia*, arise. This kind of communication is evident in these glands, for if the lacteals be loaded with chyle, we always observe the cells of those glands that join the distended lacteal vessels, likewise loaded with chyle and appearing of a white colour. I have also found the cells of the lymphatic glands, distended in a similar manner by the lymph.

These facts are sufficient to prove that the vessels enter into, and pass out of the glands; they are likewise supplied with a great number of blood vessels and nerves.

We suppose a secretion to be performed by the minute branches of the arteries, which open into these cells, or that the chyle is altered in the cells, but we are ignorant of the nature both of this secretion and alteration.

Mr. (f) Hewson is of opinion that the lacteals and lymphatic glands, as well as the thymus, secrete or form the central particles of the blood,

(e) See Page 45 of this Work.

(f) Experimental Enquiry into the Figure and Composition of the Red Particles of the Blood, &c. by W. Hewson, in Quarto 1773.

or those bodies which are found in the cavities of what he calls the red vesicles. That these glands do indeed contain particles similar to those mentioned first by Mr. Hewson, and since described and figured by the late ingenious Mr. Falconar, (g) is evident to every anatomist, who will take the trouble of examining these parts with the microscope, as directed by Mr. Falconar. But it remains yet to be determined, whether these particles be not originally formed in the chyle, while it is in the stomach, and in the intestinal canal, and consequently before it is received, into the vessels or glands.

The alterations produced in the chyle, by the action of the lacteals, and the mesenteric glands, must certainly be of the utmost consequence, though we do not yet understand the nature of them.

These glands appear to be of greater importance to young animals than to adults, and to man and quadrupeds, than to the other classes of animals. It is a remarkable circumstance, that in the foetus and children, the lacteal and lymphatic glands are exceedingly numerous, but they disappear, as we advance in age; so that in the adult human subject, there is not perhaps one tenth part of the number found in the foetus. These glands are of different sizes, as represented, in Plate III. IV. V. Their circumferences are of a round or elliptic form, while their surfaces are somewhat flattened. In the composition of these glands, we can discover nothing more, than arteries, veins, absorbent vessels, nerves, and cellular membrane; and as the vessels have muscular fibres entering into their structure, we are to consider these muscular fibres, as making a considerable portion of their substance.

The lacteal vessels of the first order having ramified, spread their branches upon the surfaces of the first order of glands, or those which are next to the intestines, and enter their cells: from hence, other trunks larger in size and less numerous than those of the first order, arise, and these are continued into the next series or order of glands, as they are

(g) Experimental Enquiries, Part III. by Magnus Falconar.

called

called. I must however acknowledge, that this division of the vessels and glands, into first, second, and third order, has no just foundation in nature, and is of very little consequence in anatomy or physiology; for we find that those lacteals, which arise from the duodenum, only pass through a small number of glands, while those which come from the lower portion of the ileon, take their course through several different glands, before they reach the thoracic duct.

The lacteal trunks continued from the first order of glands, pass on to others, as may be seen in the fifth Plate of this work; and these are connected in a similar manner, with other glands, in their passage to the receptaculum chyli and thoracic duct.

In the fifth Plate of this work, upon a portion of human jejunum, from an adult female subject, seventeen lacteal vessels are injected with quicksilver, by inserting pipes into them, upon the intestine. They were remarkably large and varicose in this subject; and as the quicksilver was poured into the lymphatic injecting tube to fill these vessels, it frequently ran out in a full stream by the jugular vein, which was opened.

This circumstance rendered it evident, that the mercury had passed through the whole course of the lacteals and thoracic duct, and had penetrated even into the venous system. It is, I believe, the only instance in which the thoracic duct has been injected from the lacteals on the intestines. In general the quicksilver which is pushed into the trunks on the intestines, goes no further than to the vessels, that enter into the first gland, with which the lacteal is connected, or to the cells of the gland. The *vasa egressiva*, or vessels emerging from the gland, are even injected from the first order of lacteals with difficulty; nor will the thoracic duct be easily injected from the second order of these vessels; at least I have been very unsuccessful, in the repeated attempts of this kind which I have made. This may be effected, however, from some of the larger trunks, on that portion of the mesentery corresponding with the upper part of the jejunum.

The

The lacteals which in this Plate form larger trunks, and are less numerous, terminate in the *receptaculum chyli*, or in the thoracic duct; for in many human subjects, this enlargement at the bottom of the thoracic duct, called (*h*) *receptaculum chyli*, into which the lacteals are inserted, is not to be found.

In the last described subject, three lacteal trunks may be seen terminating in the upper part of the *receptaculum*; and it appears to me, that, in most human subjects, the trunks of the lacteal vessels, are inserted either into the upper part of the *receptaculum*, or into the thoracic duct a little above it.

In this Plate lacteal trunks were injected on both sides of the intestines, and the seven lacteals in shadow, are those which are represented as arising from the posterior surface of the intestine. Some of the lacteals injected in this preparation are so varicose, that they resemble the links of a chain; they divide before they enter the glands, and some of the first order of lacteals, particularly a trunk, on the left of the figure, is seen to pass by the first order of glands, and to be continued to the posterior surface of a large gland which is the lowest of the three larger glands above. At letter *h*, a collateral anastomosing branch may be observed, forming a communication between the vessels of the second order, and the trunks which terminate in the thoracic duct. These lateral anastomoses are found in every part of the absorbent system, (*i*) and they are of the utmost importance in the animal œconomy; for should the glands, with which these vessels communicate below, be obstructed, the anastomosing branches, will still convey the chyle or lymph to the vessels above the obstructed gland, and this is most undoubtedly the case, in the *tabes mesenterica*. The cells of the glands, in this affection, are filled with a curdlike substance, and sometimes with calcareous earth; and in many subjects labouring under this complaint, I have found all the lacteal glands intirely obstruct-

(*b*) The *Receptaculum Chyli* has been called *Cisterna lumbaris seu vesicula Chyli*, by Haller; and lacteal Sac by the late Professor Monro and others.

(*i*) See Experimental Enquiries by Magnus Falconar, Part III. Plate II.

ed, so that when I injected the lacteals, I could not make a single particle of the quicksilver pass into the cells of the glands; but the vessels above the glands, in this instance, were injected with the greatest facility, from the vessels below the same. This is a proof that the collateral branches were increased in size, which was indeed apparent; and that they had conveyed the chyle, to the thoracic duct, without its passing through the glands.

Since the alteration which the chyle undergoes in healthy subjects, cannot take place in these distempered habits, because the cells of the glands are stuffed up, and the chyle is prevented from entering into them; may we not readily account for the subject becoming impoverished thin and consumptive in these cases? We are likewise to suppose, that these collateral branches alone, are not sufficient to convey the chyle to the thoracic duct, in such quantities, as to nourish the body. These anastomoses however, as I have observed in a former part of this work, will account for the way, in which the chyle was conveyed, into the sanguiferous system, in that extraordinary case mentioned by Mr. Cheston of Gloucester, and which I have before quoted (*h*).

I have now traced these vessels from their orifices to the *receptaculum chyli*, and thoracic duct, and conducted the chyle, into the venous system.

The reader may possibly be surprized, that I have taken no notice of the lacteal vessels belonging to the larger intestines of the human subject; but the reason is that we have not yet been able to discover them. We are however certain that there are numbers of them existing here, from the great quantity of lacteal glands found on the *mesocolon*, near the intestine: and from the faeces becoming more solid in the lower part of the *colon* and *intestinum rectum*, than in that portion of the *colon* which is near the *ileon*.

In the third page of this work I have advanced, that the human lacteals are never found distended by the fixed air generated from putrefaction.

(*h*) See Page 30 of this Work.

But I am now obliged to contradict this assertion; my ingenious assistant Mr. Trye having lately seen an instance to the contrary.

In many quadrupeds particularly in the horse and ass, we can inject the lacteals coming from the *cæcum* and *colon* with the greatest facility.

Whether the lacteals, at the root of the mesentery communicate with the lymphatic vessels, is a circumstance, which remains yet to be ascertained; but as these vessels are exactly similar in their structure, and as such a communication would be a great resource, where the glands are totally obstructed, as in the *tabes mesenterica*, or in case of an obstruction in the trunk, there is reason to suppose its existence, and in subjects affected with the *tabes mesenterica*, I believe it possible to push the quicksilver into the thoracic duct with greater facility, than in sound bodies, for the reason before given.

It is also necessary to mention that my indefatigable predecessor the late Dr. Hunter observed in his lectures, that he once found a human subject, in which there were either no valves in the absorbent system, or that they gave way to inflation; for he says he was able to distend the vessels with air, a considerable way below the thoracic duct, by blowing in a contrary direction to the course of the lymph and chyle. Unfortunately the Dr. did not inject this subject, and since that time we have never met with a similar instance.

I have now brought the first part of this work to a conclusion, and mean to proceed as soon as possible to the publication of the remainder, for which most of the Plates are already engraved.

The FRENCH and GERMAN edition of this part are in great forwardness and will soon be published.

F I N I S.

ERRATA.

- Page 4. in Note (c) for Differat. *read* Disserta.
10. line 28. *for* tnbe, *read* tube.
13. l. 31. — vessels, — vessel.
16. l. 13. *after* packthread, *add* the neck being.
17. l. 22. *for* those of, *read* as.
17. l. 24. — such tubes, — in glastubes hermetically sealed.
18. l. last after unexplored, *dele* ,
31. l. 5. *for* bone, *read* bones.
32. l. 15. — Lionet, — *Lyonet*.
34. l. 12. — dilitantur, — dilatantur.
34. l. 22. — spritu, — spiritu.
30. l. 9. note (o) ought to be placed in the line above, after the
the word distended,

E R R A T A

Page 4. in Note (c) for Different read Different.

10. line 28. for read, read read.

13. l. 21. — vessel, — vessel.

16. l. 13. after packman, add the neck being.

17. l. 22. for hole of, read as.

17. l. 24. — from top, — in substance horizontally sealed.

18. l. 11. after unexploded, add.

21. l. 2. for bone, read bone.

22. l. 17. — from, — from.

24. l. 11. — distance, — distance.

24. l. 22. — from, — from.

26. l. 2. note (c) and it to be placed in the line above, after the

the word different.

EXPLANATION OF PLATE I.

The different objects on this, and the succeeding Plate have no numbers affixed, in order, to prevent their disfiguration; they are to be reckoned numerically in horizontal lines from the right to the left hand beginning from above.

Fig. 1. represents a portion of the intestine *duodenum* from the adult human subject, opened, to expose its villose coat, upon which several *ampullulae* are seen loaded with chyle.

Fig. 2. a portion of *jejunum* suspended by a part of the mesentery is represented, the intestine is opened to shew several solitary *ampullulae*; upon that portion which is entire, a lacteal trunk is seen loaded with chyle immediately under the peritoneal coat.

Fig. 3. represents a portion of *ileon* inverted, upon which many solitary *ampullulae* may be observed loaded with chyle; in the middle of the object, a cluster of *ampullulae* is delineated, which are likewise loaded with the chyle.

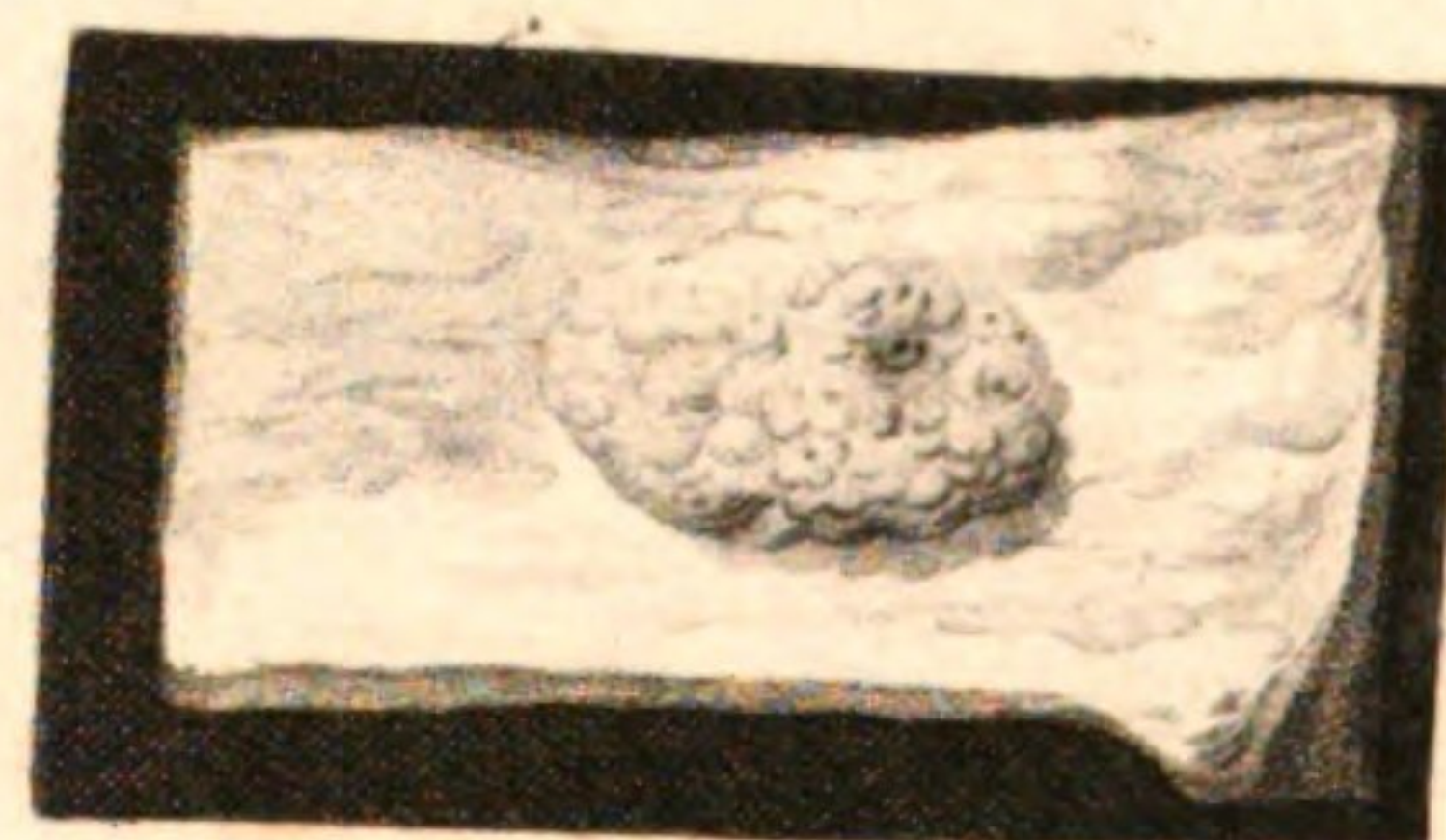
Fig. 4. two of the solitary *ampullulae* are represented, as they appeared when magnified by the opaque single microscope.

Fig. 5. represents the same *ampullulae*, of their natural size.

Fig. 6. is a delineation of a cluster of *ampullulae*.

Fig. 7. represents the same cluster magnified, and in the magnified object we thought we saw the orifices of the *ampullulae*, this appearance is demonstrated, by the specks of shadow on the cluster.

TAB. I.



R. Levesay delin.

London. Published by J. Stoddon, Jan. 1789.

C. Knight sculp.

EXPLANATION OF PLATE II

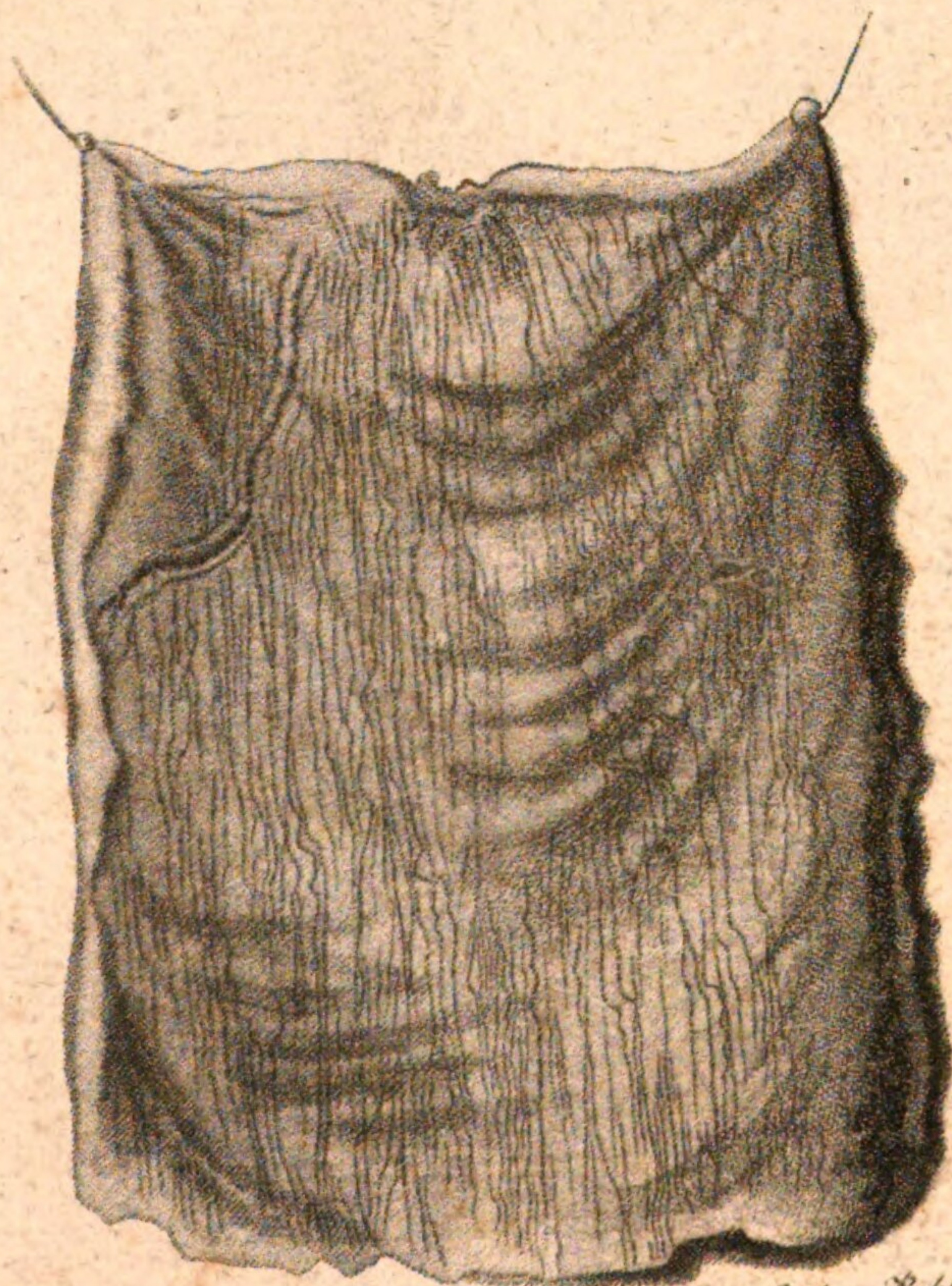
The illustration in Plate II is taken from a drawing by the artist, and is intended to show the position of the various parts of the eye, and the manner in which they are connected with each other. The drawing is a cross-section of the eye, and shows the cornea, the iris, the pupil, the lens, the vitreous body, and the retina. The various parts are labeled with letters, and the connections between them are shown by lines. The drawing is a very accurate representation of the eye, and is a valuable aid to the study of anatomy.

EXPLANATION OF PLATE II.

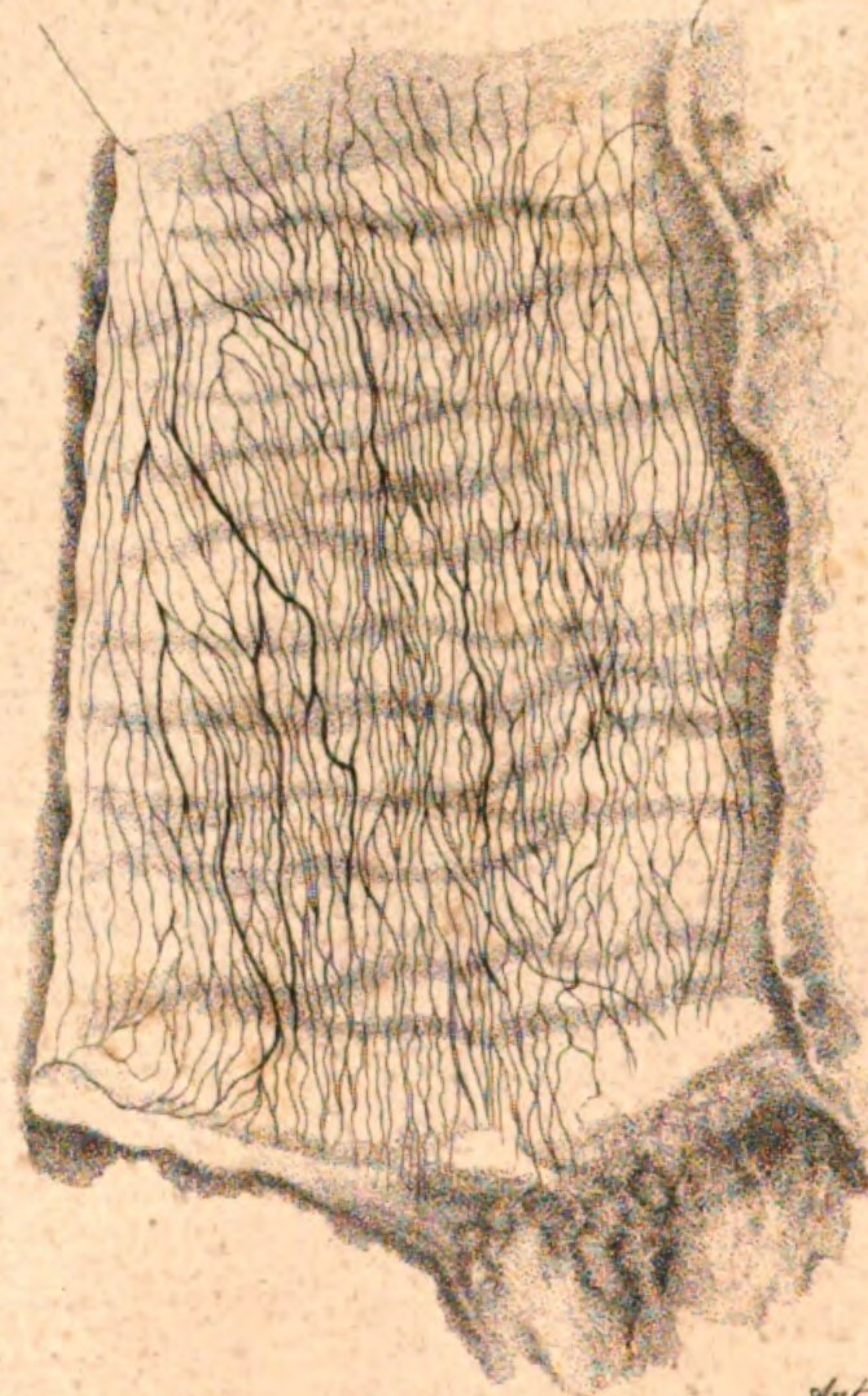
The small object in Plate II. is taken from Lieberkühns first Plate published in his *Dissertatio anatomica de Fabrica & Actione Villorum Intestinorum Hominis*. It represents two *ampullulae* magnified, which are remarkably turgid with chyle; their orifices are distinctly seen, particularly the one which opens upon the extreme point of the *ampullula*, which last is rendered evident by the speck of shadow on the point; several other orifices may be likewise observed, upon the sides of the *ampullulae*, and these are marked by specks of light; the lacteal which arises from the *ampullula* is also seen in this object. The three larger figures in this Plate exhibit the appearance of the smaller trunks and many of the branches of the lacteals, which are situated immediately under the peritoneal coat of the intestine, the minute branches of these, are continued from the vessels, which arise from the *ampullulae*, and which are represented in the last described figure. These preparations were taken from subjects who died with ulcerations, which were dispersed on the villose coat of the small intestines, and the coats of the lacteals are rendered more opaque in such subjects, from the inflammation of the blood vessels of their coats, which inflammation was most probably effected by the stimulus of the matter absorbed from the ulcers.



L. Davis delin.



Surah Stone delin.



Ant. Scarpa Anat. Prof. delin.

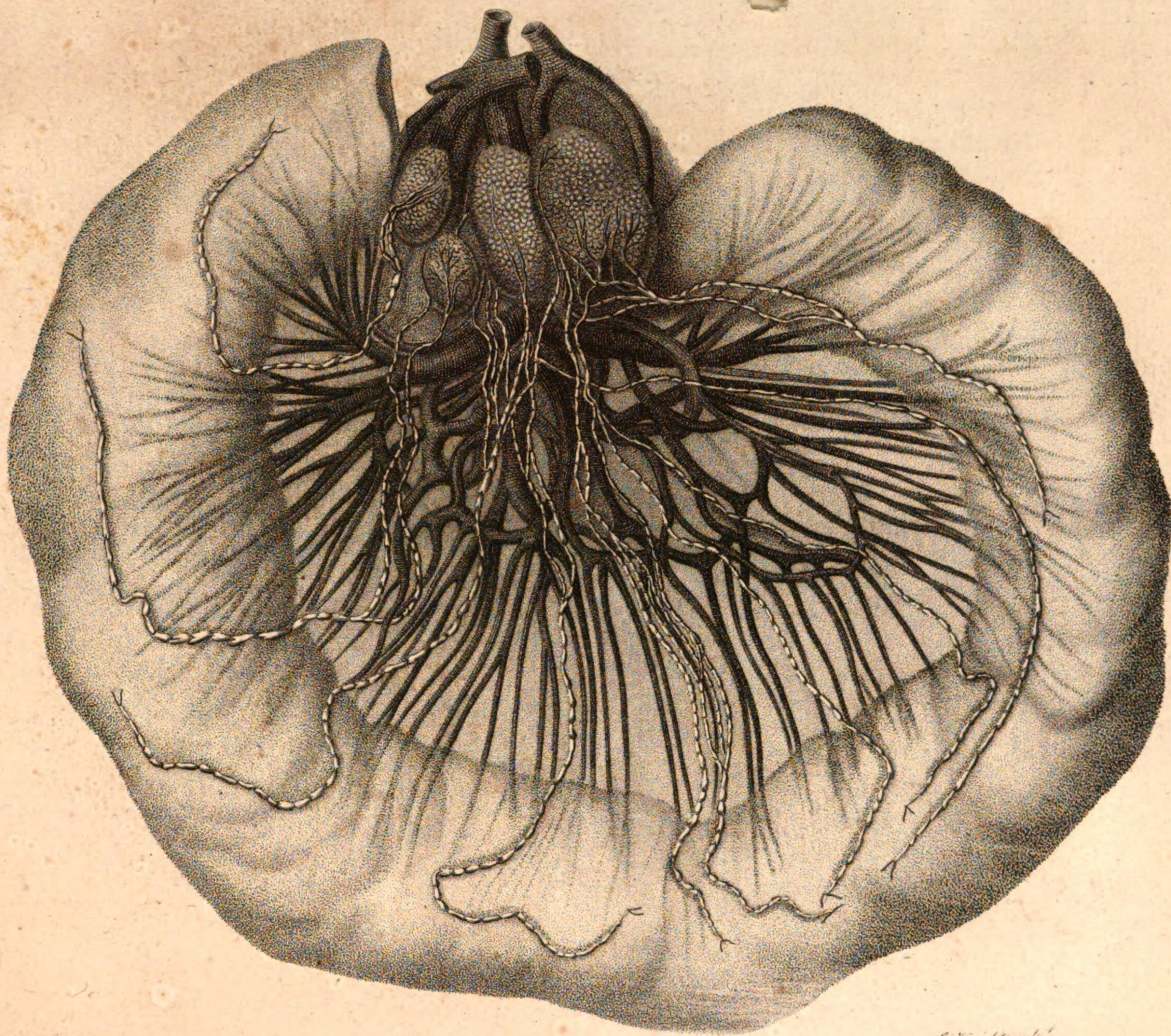
C. Knight sculp.

EXPLANATION OF PLATE III.

In this Plate ten lacteals of the first orders injected with quicksilver are represented. The anterior layer of peritoneum, is dissected from the mesentery, to shew their course from the intestine, to the first order of glands; the trunks on the intestine and mesentery are serpentine, and on the intestine they run in the longitudinal direction of the canal; the numerous valves which are found in these vessels produce the knotted appearance which is seen in the lacteals represented in this Plate. These vessels do not follow the course of the blood vessels, but run on to the first order of lacteal glands, upon the surface of which they spread their branches, having previously divided, the finer ones enter the internal substance of the glands, and open into their cells; and this is represented in the upper part of the figure, these cells are loaded with the quicksilver; and in this preparation we may observe that the cells contained in the smaller glands were less than those in the larger. The vessels placed in shadow behind the lacteal vessels, are the arteries and veins which were filled with red and blue injection. The preparation was made from a portion of the *intestinum jejunum* of an adult human subject.

N. B. The lacteal which runs across and behind some of the lacteal vessels, that are situated in the middle of this object, and which appears to enter a branch of the third lacteal trunk reckoning from left to right, did not enter this vessel but ran behind, and afterwards entered a gland on the opposite side of the mesentery.

TAB. III.



Aut. Scarpa Anat. Prof. edin.

C. Knight sculp.

London. Published by J. Sheldon, Jan. 7. 1782

EXPLANATION OF PLATE I.

This figure represents a section of a human brain, showing the internal structure of the cerebrum. The section is taken in a plane parallel to the base of the brain, and is shown in a perspective view. The various parts of the brain are labeled with letters, and the following table gives a description of each part.

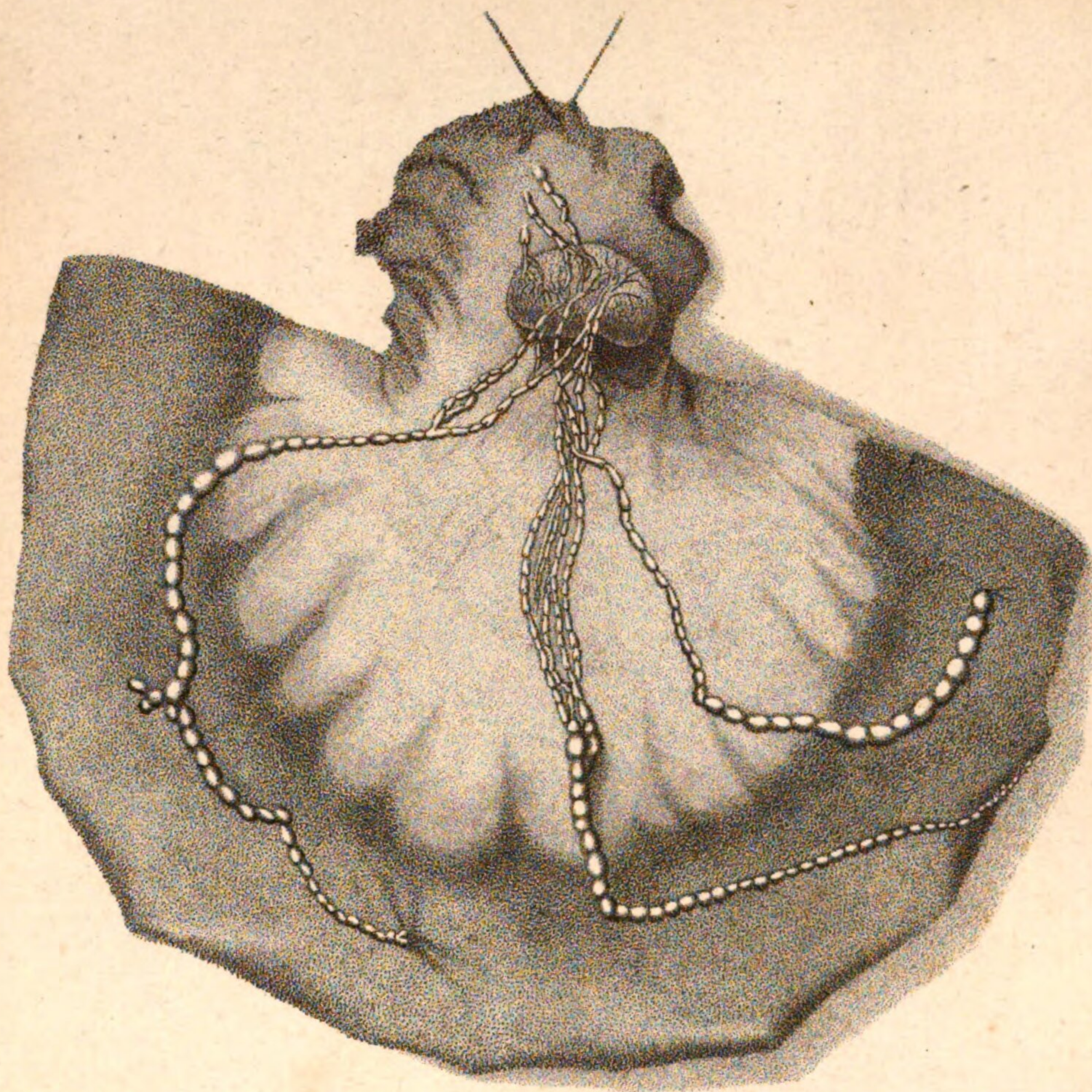
Letter	Description
A	Superior surface of the cerebrum
B	Superior surface of the cerebellum
C	Superior surface of the medulla oblongata
D	Superior surface of the pons
E	Superior surface of the medulla oblongata
F	Superior surface of the pons
G	Superior surface of the medulla oblongata
H	Superior surface of the pons
I	Superior surface of the medulla oblongata
J	Superior surface of the pons
K	Superior surface of the medulla oblongata
L	Superior surface of the pons
M	Superior surface of the medulla oblongata
N	Superior surface of the pons
O	Superior surface of the medulla oblongata
P	Superior surface of the pons
Q	Superior surface of the medulla oblongata
R	Superior surface of the pons
S	Superior surface of the medulla oblongata
T	Superior surface of the pons
U	Superior surface of the medulla oblongata
V	Superior surface of the pons
W	Superior surface of the medulla oblongata
X	Superior surface of the pons
Y	Superior surface of the medulla oblongata
Z	Superior surface of the pons

EXPLANATION OF PLATE IV.

This figure represents a portion of *jejunum* from an adult human subject, it was dried, and rendered semi-transparent by being immersed in oil of turpentine.

In this Plate three lacteal vessels injected with quicksilver are delineated; they were remarkably varicose upon the intestine, but they lose this appearance soon after they quit it; the middle one breaks into four branches and forms a beautiful appearance, the lacteal on the left likewise divides, and enters the gland as well as the one before described, the lacteal on the right, joins one of the branches of the middle lacteal trunk; the cells of the gland are injected, and three of the egredient vessels or lacteals of the second order are seen emerging from it.

TAB. IV.



J. Bone delin.

London. Published by J. Sheldon, Jan. 1782.

C. Knight sculp.

EXPLANATION OF PLATE V.

The preparation from which this Plate was engraved, consisted of a portion of *jejunum* with it's mesentery taken from an adult human subject.

A. The intestine *jejunum* with it's mesentery.

B. B. Part of the thoracic and the whole of the abdominal portion of the *aorta descendens*.

C. The *receptaculum chyli* or lacteal sac, into which the three trunks of the lacteal vessels marked *i* open.

D. The thoracic duct.

a. The coeliac artery. *b.* The superior mesenteric artery.

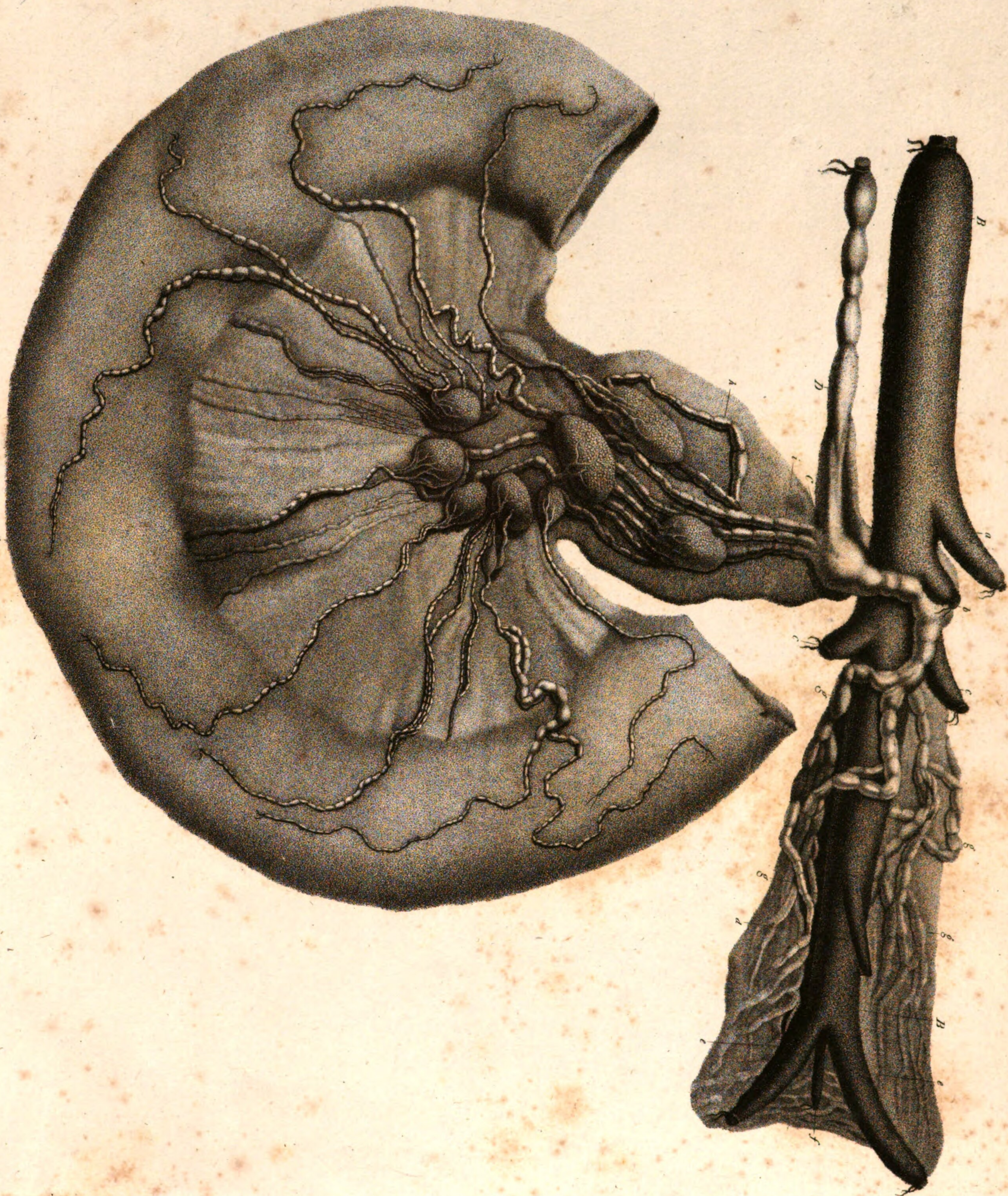
c. c. The emulgent arteries. *d.* The inferior mesenteric artery.

e. e. The iliac arteries. *f.* The sacral artery.

g g g g. The trunks belonging to the lymphatic vessels of many of the abdominal viscera and inferior extremities: these with the trunks of the lacteals described above, compose the thoracic duct; the *receptaculum chyli* and the two trunks of these lymphatics form a vascular ring which encircles the aorta under the superior mesenteric artery, these trunks unite and produce the first beginning of the thoracic duct *D*.

Upon this portion of intestine seventeen lacteals were injected with quicksilver, some of them were remarkably varicose and serpentine, and all the trunks run in the longitudinal direction upon the intestinal canal; nine lacteals are injected upon the anterior surface of the intestine, the others were injected upon the opposite surface of the same, and these may be distinguished by their being kept in shadow, and from the vessels being traced by the eye no further than the superior edge of the intestine. The lacteals of the first order, pass into the glands which are nearest to the intestine, they emerge from the first order of glands, and pass into others in their way to the thoracic duct; the lacteals in this preparation may be divided into the *vasa lactea primi, secundi, tertii & quarti generis*. A lacteal of the first order, the second trunk on the left of the object, escapes the first order of glands, and enters a gland of the second order; it appears convoluted on the mesentery, but this depended upon that part of the mesentery being folded, upon which this portion of the lacteal was situated, it passed afterwards to the the posterior surface of the gland, which is placed immediately above the first order of glands, and entered it's cells.

Four lacteals of the second order are seen arising from the first order of glands; most of these are connected with the two glands which are situated next to them, and from these glands, other lacteal trunks of the third order arise, some of these pass into a gland in their way to the thoracic duct, they afterwards unite and from three lacteal trunks, which pass into the *receptaculum chyli*; at *h.* a lacteal is seen producing an anastomosis between the lacteals of the second order, and one of the trunks which are connected with the *receptaculum chyli*.



A. Livingey pinxit.

London: Published by J. Stedon, Jan. 1792.

A. Stedon sculpit.

EXPLANATION OF PLATE VI.

Fig. 1. represents the lymphatic injecting tube of the proper size; it is made of glass; the superior extremity of the tube is formed like the upper part of a funnel, for the convenience of pouring in the quicksilver, the other end has a collar of steel *a.* cemented to the tube, which contains a female screw *b.* to receive the steel pipe,

Fig. 2. By means of a small screw *c.* Letter *d.* marks the godronned edge, which is made to fix the fingers to screw or unscrew the pipe. *e.* The pipe which is inserted into the lymphatic vessel.

Fig. 3. Is a poker made of iron wire to clean the cavity of the pipe.

Fig. 4. Is a curved pipe, which is sometimes used in injecting lymphatic vessels.

Fig. 5. Is a curved iron poker to clean the same.

Fig. 6. Represents the brass injecting tube of the form it is usually made by the workmen in London. *a.* Is a collar of the same metal, which contains a female screw, as in the last described.—The upper end of the tube might be made like the glass one to advantage.

Fig. 7. Represents a steel pipe, similar to the one first described, except instead of the godronned edge, the piece of iron into which the steel pipe is fixed, is made square at *b.* to adapt a plate of iron or brass,

Fig. 8. Which has a square hole *a.* to receive the square piece *b.*; by the assistance of this Plate the pipe can be screwed or unscrewed with great facility.

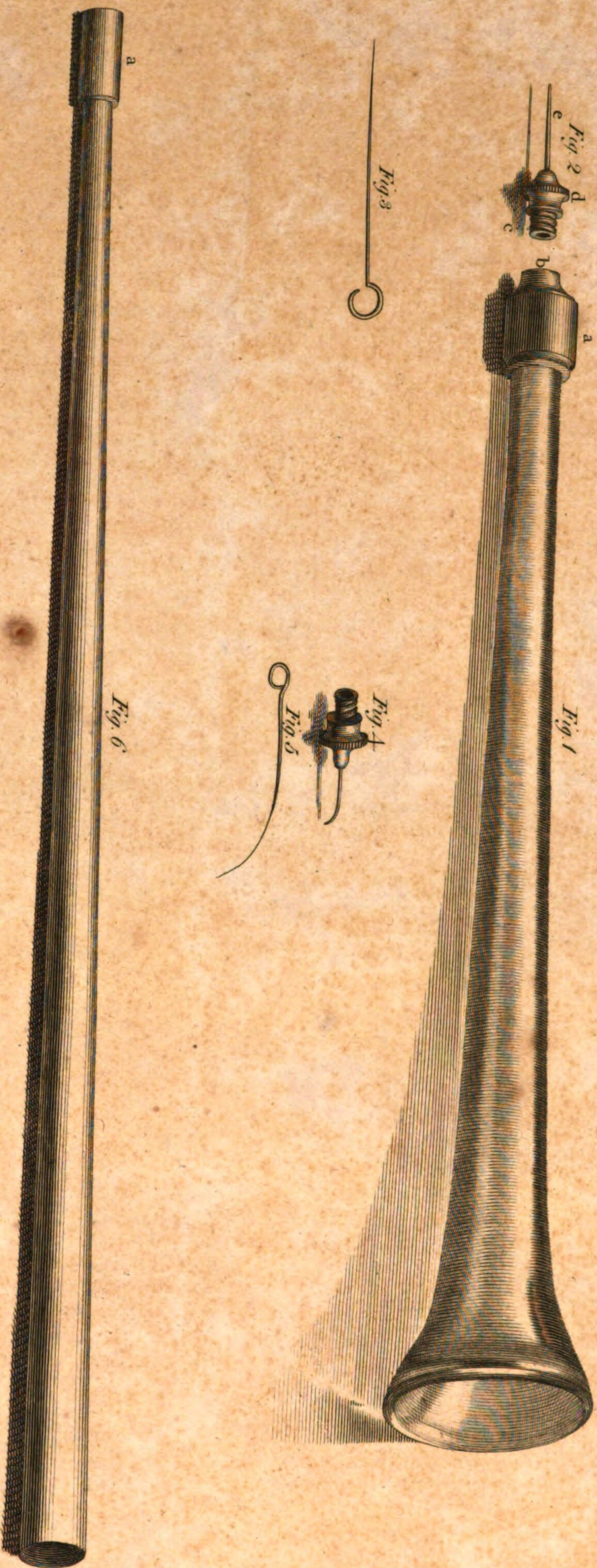


Fig. 6

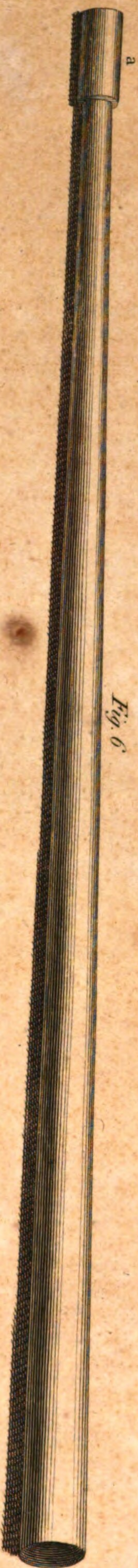
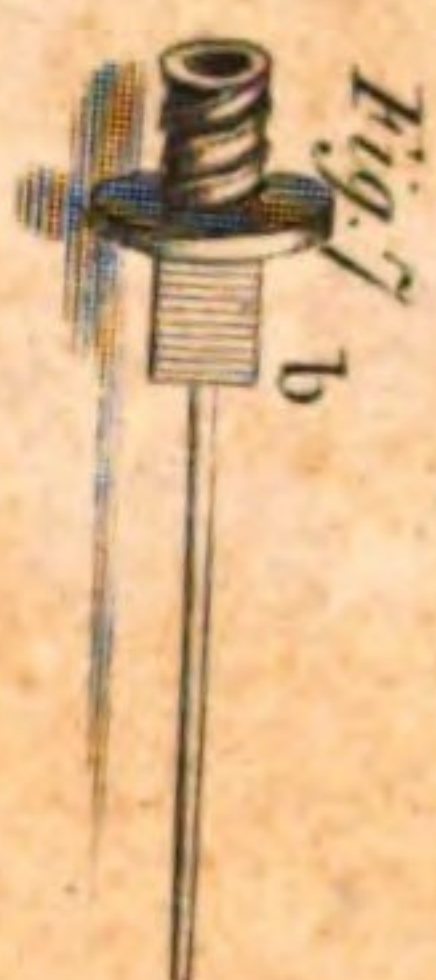
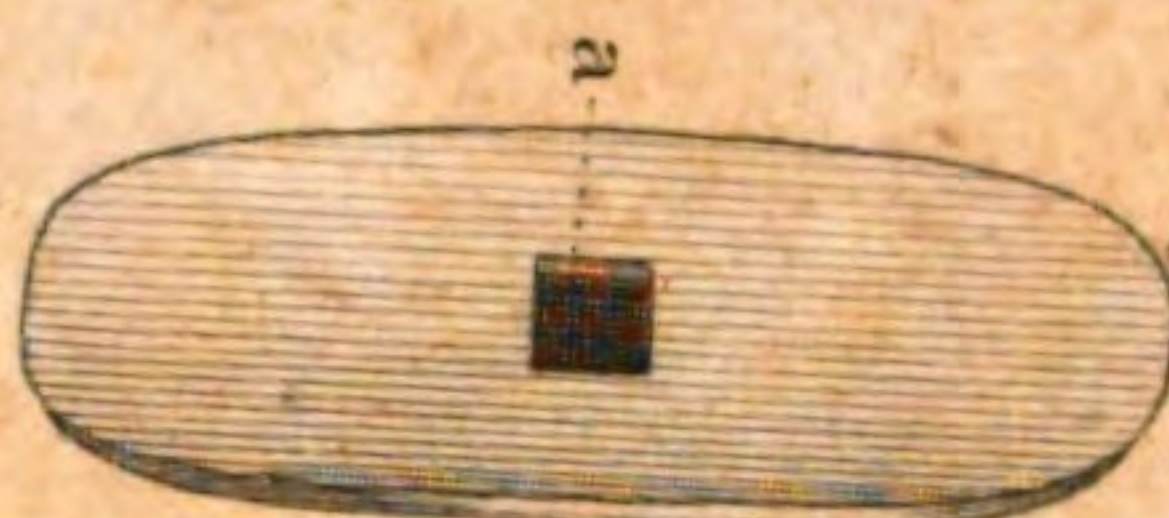
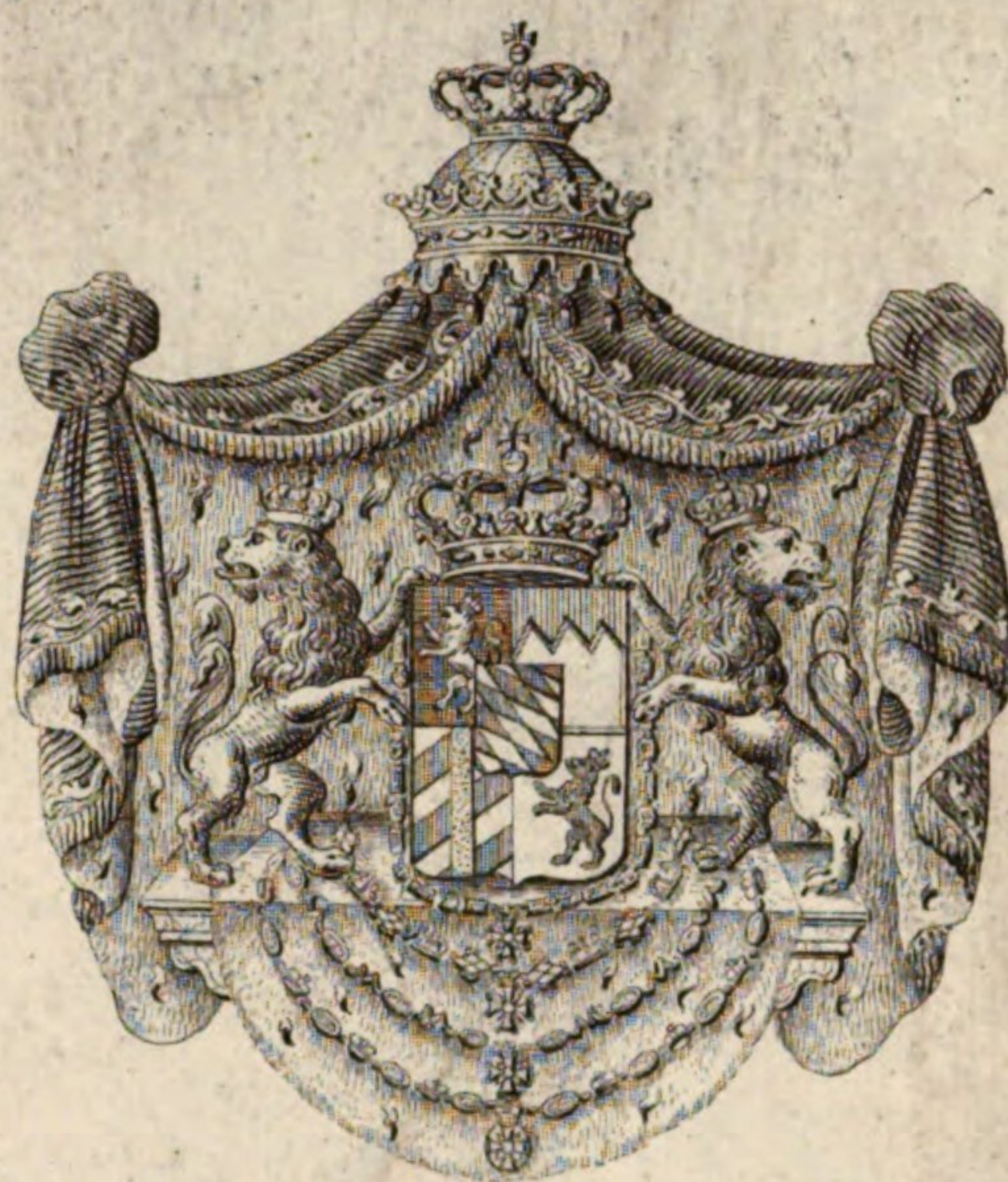


Fig. 8



Robt. M. Allen

James Watson & Co.



BIBLIOTHECA
REGIA
MONACENSIS.



Sheldon, John

The history of the absorbent system

Bd.: 1. Containing the chylography. - 1784. - 6 Bl., VI, 52 S. : 6 Ill.

London 1784

2 Anat. 64 t-1

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